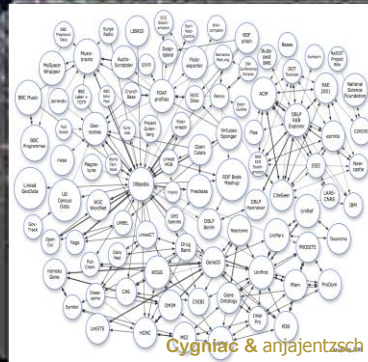


Knowledge for/from People for/from Computers

Michael Witbrock

Cycorp Europe

witbrock@cycorp.eu



Cygniac & anjajentsch



Michael Witbrock
Cycorp, witbrock@cycorp.eu
Oct 28th 2011

- **Human Computer Collaboration**

- Vast power: fast communications, near infinite memory, computational learning (recommendation, data mining)

- *Fundamentally Harder Problems*

- This power is creating systems that are more complex than can be managed by unaided humans

- *Fundamental Change*

- Much content not stored in human understandable form (text, audio, diagrams ...) but dynamically combined and synthesized

- *Needs infrastructure*

- Knowledge in machine understandable form
- Background knowledge to provide that understanding



What's all this about people and computers

Use Case: Semantic Patient Records

Reasoning-based, question answering

The screenshot displays a software interface with the following components:

- Task Info** | **Document Search** | **Concepts** | **Queries**
- Search input:
- Search Results**
 - Find patients with bacteremia after a pericardial window
 - Simple Questions
 - The patient ID for PATIENT is _____.
 - PATIENT is the patient involved in _____ and PATIENT is the patient involved in _____.
 - PATIENT is the patient involved in _____ and _____ is a pericardial window.
 - _____ is a case of bacteremia.
 - _____ involves _____.
 - _____ is after _____.
 - PATIENT is the _____ procedure performed on _____.
 - _____ contain _____.
 - _____ is a surgical _____.
 - Keyword Search
 - CCF Query Library
 - CAEUser : Generic Medical Research Task Environment
 - Search History

A context menu is open over the 'Simple Questions' section, containing the following options:

- Copy Query Text
- Open
- Delete
- Combine selected queries

A tooltip 'Attempt to combine the two queries' is positioned near the 'Combine selected queries' option.

User-assisted query understanding



Task Info Document Search Concepts Queries

- Give the values of *BLOODSTREAM-INFECTION*, *ID* and *PERICARDIAL-PROCEDURE* such that:
 - All of the following are true
 - The patient ID for *PATIENT* is *ID*.
 - PERICARDIAL-PROCEDURE* is a pericardial window.
 - PATIENT* is the patient involved in *PERICARDIAL-PROCEDURE*.
 - BLOODSTREAM-INFECTION* is a case of bacteremia.
 - PATIENT* is the patient involved in *BLOODSTREAM-INFECTION*.
 - PERICARDIAL-PROCEDURE* is before *BLOODSTREAM-INFECTION*.
 - BLOODSTREAM-INFECTION* happened between 1999 and 2006.

Ask

Save

New Tab

Stop

Palette

- BLOODSTREAM-INF...
- PERICARDIAL-PRO...



Context: always Edit...

Results: All Time limit: 600

More...

Answers

Bloodstream infection	Id	Pericardial procedure

In use at the Cleveland Clinic (one of largest US hospitals)

Valve Surgery

Search

Semantic Search Results

Valve Disease

104 [Valve operations](#) performed for the treatment of endocarditis in 2006. 73 procedures... [Valve Procedure](#) Volume Cleveland Clinic continues to perform the largest number of [valve procedures](#) in the United States. In 2006, Cleveland Clinic surgeons performed 2,127 [valve procedures](#)1,524

http://tomcat/html-content/Valve_Disease_.html (cached)

Eric E. Roselli, M.D.

Eric E. Roselli, M.D. Specialties: Adult cardiac surgery, thoracic aortic surgery, endovascular approaches to cardiothoracic diseases, minimally invasive [valve repair](#) and replacement, high-risk [valve surgery](#), peripheral vascular surgery,

http://tomcat/html-content/roselli_.html (cached)

A. Marc Gillinov, M.D.

A. Marc Gillinov, M.D. Specialties: Minimally invasive mitral valve, aortic valve, and tricuspid valve surgery; [mitral valve repair](#),...; and high-risk [mitral valve surgery](#). Medical Degree:

http://tomcat/html-content/gillinov_.html (cached)

Gosta B. Petterson, M.D., Ph.D.

[valve surgery](#); heart and lung transplantation; reoperations; endocarditis; complex coronary artery surgery; aortic and [mitral valve repair](#)/replacement (including the Ross procedure); and adult... Dr. Gosta Petterson has performed 387 [valve operations](#) at Cleveland Clinic since 1999.

http://tomcat/html-content/petterson_PettersonValveProc.html (cached)

Minimally Invasive

Isolated valve procedure CABG + [valve procedure valve procedure](#) +... VIDEO-ASSISTED MITRAL/[TRICUSPID VALVE PROCEDURE](#) Video-assisted mitral/tricuspid valve surgery is a minimally invasive technique enabling [valve repair or replacement](#) to be performed without sternotomy.

http://tomcat/html-content/Minimally_Invasive_.html (cached)

Intelligent Search

Semantic Search Results

[A. Marc Gillinov, M.D.](#)

A. Marc Gillinov, M.D. Specialties: Minimally invasive mitral valve, aortic valve, and tricuspid valve surgery; mitral [valve repair](#), surgical... Gillinov, M.D. has performed 125 [heart-valve repair](#) operations at [http://tomcat/html-content/gillinov_GillinovHeartValveRepair.html \(cached\)](http://tomcat/html-content/gillinov_GillinovHeartValveRepair.html (cached))

[Valve Disease](#)

[AV Repair or Replace + Other AV Repair or Replace](#)
Replacements AV = Aortic
http://tomcat/html-content/Valve_Disease

[Nicholas G. Smedira, M.D.](#)

Nicholas G. Smedira, M.D. Specialties: Heart valve replacement, off-pump coronary artery bypass grafting
[http://tomcat/html-content/smedira_html \(cached\)](http://tomcat/html-content/smedira_html (cached))

[Joseph F. Sabik III, M.D.](#)

Joseph F. Sabik III, M.D. Specialties: Adult cardiac surgery, off-pump coronary artery bypass grafting
[http://tomcat/html-content/sabik_html \(cached\)](http://tomcat/html-content/sabik_html (cached))

[Eric E. Roselli, M.D.](#)

Eric E. Roselli, M.D. Specialties: Adult cardiac surgery and replacement, high-risk valve surgery
[http://tomcat/html-content/roselli_html \(cached\)](http://tomcat/html-content/roselli_html (cached))

[Gosta B. Pettersson, M.D., Ph.D.](#)

Gosta B. Pettersson, M.D., Ph.D. Specialties: Aortic and mitral [valve repair/replacement](#)
[http://tomcat/html-content/pettersson_html \(cached\)](http://tomcat/html-content/pettersson_html (cached))

A. Marc Gillinov, M.D.

Specialties: Minimally invasive mitral valve, aortic valve, and tricuspid valve surgery; mitral valve repair, surgical treatment and minimally invasive surgery for atrial fibrillation; off-pump coronary artery bypass surgery; and high-risk mitral valve surgery.

Medical Degree: Johns Hopkins University School of Medicine, Baltimore, Maryland

Special Training: Johns Hopkins University School of Medicine, Baltimore, Maryland

A native Clevelander, Dr. Gillinov spent the summers of 1978 to 1980 dividing his time between working at Cleveland Clinic and playing tennis. He still enjoys both activities.



Gillinov, M.D. has performed 125 [heart-valve repair](#) operations at the Cleveland Clinic Foundation since 1998.



This graph, based on a small sample of patient data, is given for demonstration purposes only.

Content adapted to query: Heart Valve repairs by Dr. Gillinov

Content adaptation: heart valve repair

Intelligent Search

Semantic Search Results

[A. Marc Gillinov, M.D.](#)

Gillinov, M.D. has performed 316 [coronary artery](#) operations at the Cleveland Clinic... invasive mitral valve, [aortic](#) valve, and tricuspid valve surgery repair, surgical treatment and minimally invasive surgery for atrial fibrillation; off-pump [coronary](#) artery bypass surgery http://tomcat/html-content/gillinov_GillinovCoronaryArtery.html (cached)

[Nicholas G. Smedira, M.D.](#)

and heart-lung transplantation, ventric
grafting, myectomy, reoperations, and
http://tomcat/html-content/smedira_h

[Gosta B. Pettersson, M.D., Ph.D.](#)

Adult acquired heart disease (includi
complex [coronary artery](#) surgery; [aort](#)
<http://tomcat/html-content/pettersson>

[Joseph F. Sabik III, M.D.](#)

Joseph F. Sabik III, M.D. Specialties: A
surgery, off-pump [coronary](#) artery bype
http://tomcat/html-content/sabik_html

[Coronary Disease](#)

Primary isolated CABG refers to a pat
images... excellent long-term patency
http://tomcat/html-content/Coronary_D

[Bruce W. Lytle, M.D.](#)

Bruce W. Lytle, M.D. Chairman, D
diseases, reoperations, diseases of th
http://tomcat/html-content/lytle_html

A. Marc Gillinov, M.D.

Specialties: Minimally invasive mitral valve, aortic valve, and tricuspid valve surgery; mitral valve repair, surgical treatment and minimally invasive surgery for atrial fibrillation; off-pump coronary artery bypass surgery; and high-risk mitral valve surgery.

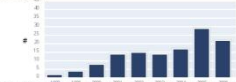
Medical Degree: Johns Hopkins University School of Medicine, Baltimore, Maryland

Special Training: Johns Hopkins University School of Medicine, Baltimore, Maryland

A native Clevelander, Dr. Gillinov spent the summers of 1978 to 1980 dividing his time between working at Cleveland Clinic and playing tennis. He still enjoys both activities.



Gillinov, M.D. has performed 125 heartvalve repair operations at the Cleveland Clinic Foundation since 1998.



This graph, based on a small sample of patient data, is given for demonstration purposes only.

A. Marc Gillinov, M.D.

Specialties: Minimally invasive mitral valve, aortic valve, and tricuspid valve surgery; mitral valve repair, surgical treatment and minimally invasive surgery for atrial fibrillation; off-pump coronary artery bypass surgery; and high-risk mitral valve surgery.

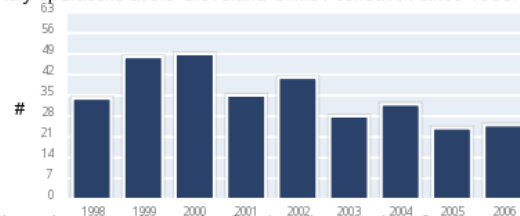
Medical Degree: Johns Hopkins University School of Medicine, Baltimore, Maryland

Special Training: Johns Hopkins University School of Medicine, Baltimore, Maryland

A native Clevelander, Dr. Gillinov spent the summers of 1978 to 1980 dividing his time between working at Cleveland Clinic and playing tennis. He still enjoys both activities.



Gillinov, M.D. has performed 316 coronary artery operations at the Cleveland Clinic Foundation since 1998.



This graph, based on a small sample of patient data, is given for demonstration purposes only.

Content adapted to new query: *Artery* repairs by Dr. Gillinov

Content adaptation: coronary artery

EVENT \supset TEMPORAL-THING \supset PARTIALLY-TANGIBLE-THING

Upper
Ontology

$(\forall a, b) a \in \text{EVENT} \wedge b \in \text{EVENT} \Rightarrow$
 $\text{causes}(a, b) \Rightarrow \text{precedes}(a, b)$

Core
Theories

$(\forall m, a) m \in \text{MAMMAL} \wedge a \in \text{ANTHRAX} \Rightarrow$
 $\text{causes}(\text{exposed-to}(m, a), \text{infected-by}(m, a))$ \square

Domain-Specific
Theories

Very specific information
(some indirect, via SKSI)

(ist FtLaudHolyCrossERCCase#403921
(caused CutaneousAnthrax
(SkinLesions Ahmed_al-Haznawit)))

First Order Predicate Calculus: unambiguous; enable mechanical reasoning

Every American has a president.
Every American has a mother.

Higher Order Logic: contexts,
predicates as variables,
nested modals, reflection,...

$\exists y. \forall x. \text{Amer}(x) \Rightarrow \text{president}(x, y)$
 $\forall x. \exists y. \text{Amer}(x) \Rightarrow \text{mother}(x, y)$

Formal Representation for Reasoning

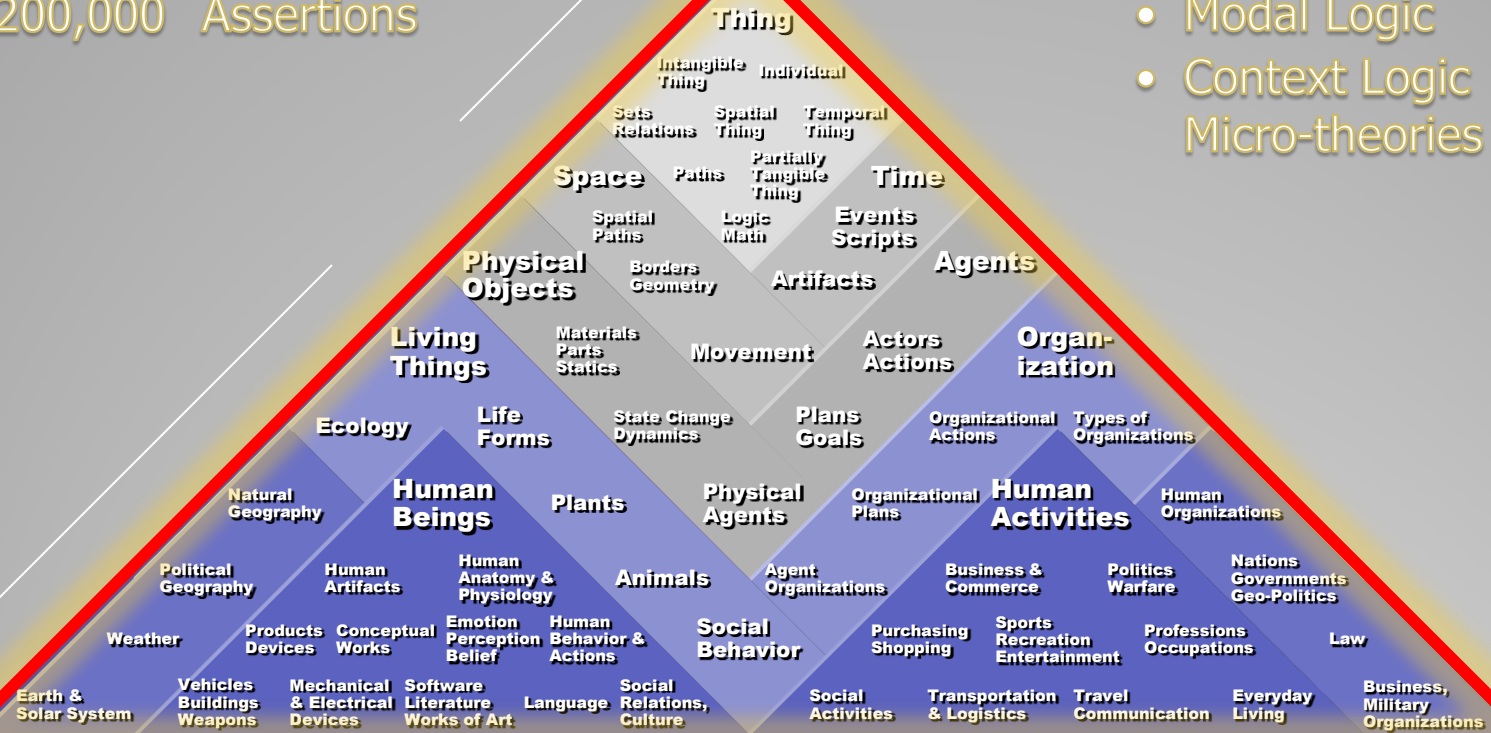


Cyc contains:

15,000 Predicates
300,000 Concepts
3,200,000 Assertions

Represented in:

- First Order Logic
- Higher Order Logic
- Modal Logic
- Context Logic
- Micro-theories



General Knowledge about Various Domains

Specific data, facts, and observations

- **#\$TransportationEvent**
- **#\$ControllingATransportationDevice**
- **#\$TransportWithMotorizedLandVehicle**
- **(#\$SteeringFn #\$RoadVehicle)**
- **#\$TransporterCrashEvent**
- **#\$VehicleAccident**
- **#\$CarAccident**
- **#\$Colliding**
- **#\$IncurringDamage**
- **#\$TippingOver**
- **#\$Navigating**
- **#\$EnteringAVehicle ...**

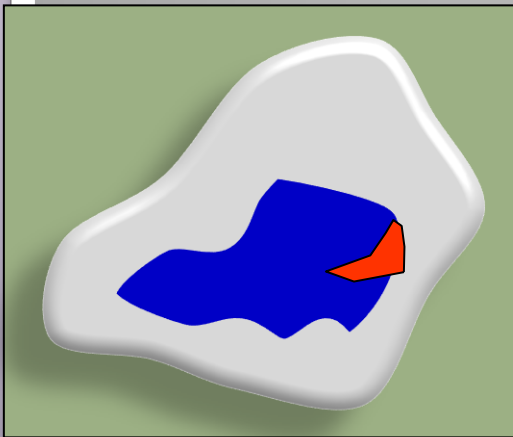


Simple Language, MANY terms

Is it attached to the inside of the outer object?

– Yes -- Try

#\$connectedToInside



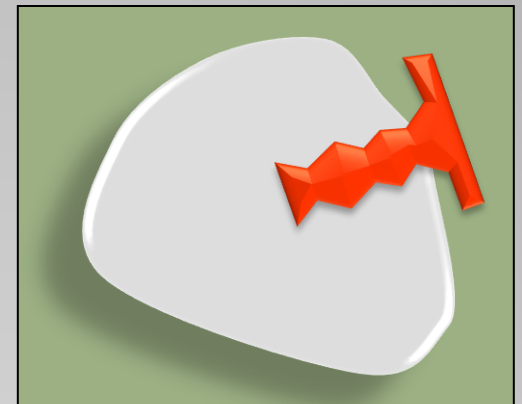
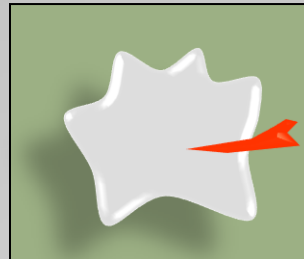
Can it be removed by pulling, if enough force is used, without damaging either object?

– No -- Try **#\$in-Snugly**
or **#\$screwedIn**

Does the inner object stick into the outer object?

–Yes – Try

#\$sticksInto

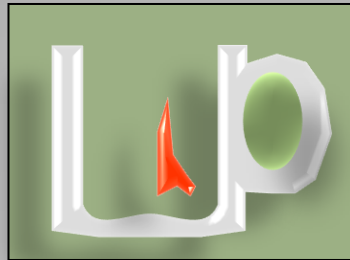


Senses of 'In'

- Does part of the inner object stick out of the container?

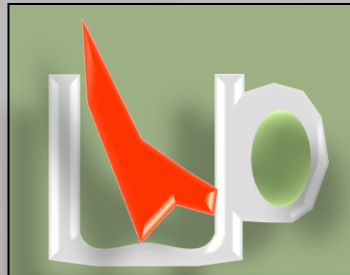
- None of it.

#\$in-ContCompletely



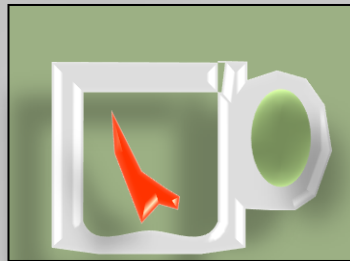
- Yes

#\$in-ContPartially



- No

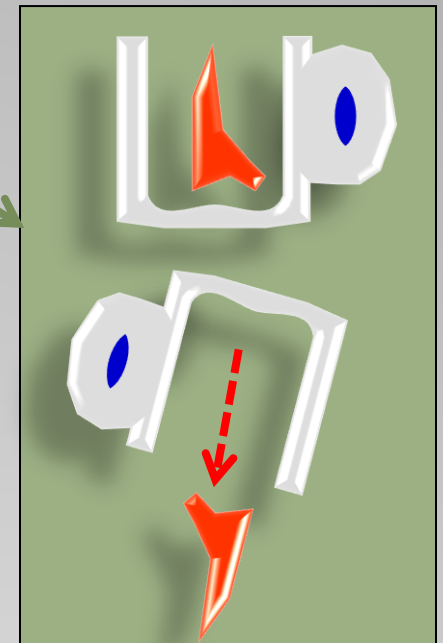
#\$in-ContClosed



- If the container were turned around could the contained object fall out?

Yes

#\$in-ContOpen



For Inference:

Senses of 'In'



First Order

- (isa ASBFinancialCorp PubliclyHeldCorporation)
- (corporateOfficers ASBFinancialCorp GeraldRJenkins)

With Context

- In Mt : FinancialTransactionMt
(relationAllExists performedBy RepurchaseProgram PubliclyHeldCorporation)

Rule

- In Mt: FinancialTransactionMt
(forAll ?X (implies
 (isa ?X RepurchaseProgram)
 (thereExists ?Y (and (isa ?Y PublicallyHeldCorporation) (performedBy ?X ?Y))))))

Second Order

- (implies
 (and (isa ?SET Set-Mathematical) (cardinality ?SET 1) (elementOf ?THING ?SET))
 (equals ?SET (TheSet ?THING)))

Modal

- (beliefs Israel (relationInstanceExists possesses Syria ClusterBomb))

Meta

- (opaqueArgument beliefs 2)

Syntactic Power

Logistics



<http://ws.opencyc.org/webservices/concept/find?str=shipping%20container>

```
<concepts hasMore="false">
```

```
  <concept uri="http://sw.opencyc.org/concept/Mx4r8qkxXAW-QdmV1JNL5SFyIA"/>
```

```
</concepts>
```

Logistics

OpenCyc (Current): [<http://sw.opencyc.org/concept/Mx4r8qkxXAW-QdmV1JNL5SFyIA>]

OpenCyc (Versioned): [<http://sw.opencyc.org/2008/06/10/concept/Mx4r8qkxXAW-QdmV1JNL5SFyIA>]

http

Search



OpenCyc Collection: shipping container

Unique ID: [Mx4r8qkxXAW-QdmV1JNL5SFyIA]

English ID: [LargePortableCargoContainer]

English Aliases: ["cargo container", "cargo containers", "portable cargo container", "portable cargo containers", "shipping containers"]

A specialization of StorageConstruct. Each instance of LargePortableCargoContainer is a large (usually about 40' x 8' x 8') metal container used for shipping large quantities of goods across land (e.g., on a large truck) or overseas (e.g., on a cargo ship).

A Type of: storage device

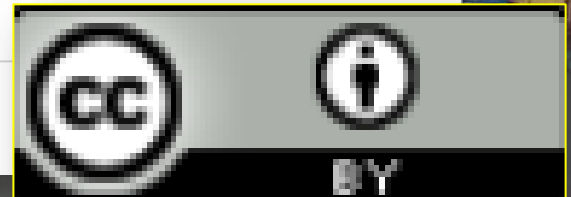
Instance of: spatially disjoint object type, type of object

Subtypes:

Instances:

Same as:

<http://umbel.org/umbel/sc/LargePortableCargoContainer>



Search at *sw.opencyc.org*

OpenCyc (Current): [<http://sw.opencyc.org/concept/Mx4r8qkxXAW-QdmV1JNL5SFyIA>]

OpenCyc (Versioned): [<http://sw.opencyc.org/2008/06/10/concept/Mx4r8qkxXAW-QdmV1JNL5SFyIA>]

OpenCyc: shipping (20 concepts)

[shipping \[HiringForWorkOnAShip\]](#)

A collection of events; a subcollection of [EmployeeHiring](#). In each [HiringForWorkOnAShip](#), someone hires someone else for work on a ship.

<http://sw.opencyc.org/concept/Mx4rOlVkerGmEdmAAAACs6hRjg>

[shipping](#)

Shipping of objects from one physical location to another. Shipping from the perspective of being done as a dedicated service, such as what UPS, the US Postal Service, or Dominoes Pizza Delivery might do.

<http://sw.opencyc.org/concept/Mx4rvVj6n5wpEbGdrcN5Y29ycA>

[shipping address \[ShippingAddress\]](#)

A specialization of [MailingAddress](#). Each instance of [ShippingAddress](#) is a mailing address which does not include a P.O. Box number. Typically then, a shipping addresses includes a street name and number and often an apartment or suite number. For example: `3721 Executive Center Drive, Suite 100, Austin, TX 78731', the shipping address of Cycorp.

<http://sw.opencyc.org/concept/Mx4rvVjRyZwpEbGdrcN5Y29ycA>

[shipping-receiving clerk \[shipping and receiving clerk\]](#)

The collection of all shipping-receiving clerks. A type of [DeskWorker](#). [Shipping_ReceivingClerk](#) is a [PersonTypeByOccupation](#).

<http://sw.opencyc.org/concept/Mx4rvVjdMJwpEbGdrcN5Y29ycA>

[shipping and receiving department \[ShippingAndReceivingDepartment\]](#)

A specialization of [Department](#). Each instance of this collection is an organization's centralized office for dispatching (material) items to the outside world, and also accepting them as they come in.

<http://sw.opencyc.org/concept/Mx4rvVklcZwpEbGdrcN5Y29ycA>

Container

"cargo container",

[CargoContainer](#) is a large (usually) container of goods across land (e.g., on a

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Search at *sw.opencyc.org*

OpenCyc (Current): [<http://sw.opencyc.org/concept/Mx4rvVj6n5wpEbGdrcN5Y29ycA>]

OpenCyc (Versioned): [<http://sw.opencyc.org/2008/06/10/concept/Mx4rvVj6n5wpEbGdrcN5Y29ycA>]

shipping

Search

[shipping](#)

A collection

someone has

<http://sw.opencyc.org/concept/Mx4rvVj6n5wpEbGdrcN5Y29ycA>

[shipping](#)

Shipping of

being done

Pizza Deliv

<http://sw.opencyc.org/concept/Mx4rvVj6n5wpEbGdrcN5Y29ycA>

[shipping](#)

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Executive

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[shipping-](#)

The collec

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[shipping](#)

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OpenCyc Collection: shipping

Unique ID: [[Mx4rvVj6n5wpEbGdrcN5Y29ycA](http://sw.opencyc.org/concept/Mx4rvVj6n5wpEbGdrcN5Y29ycA)]

English ID: [[Shipping](#)]

English Aliases: ["had sent", "had shipped", "has sent", "has shipped", "have sent", "have shipped", "send", "sending", "sends", "sent", "ship", "shipment", "shipments", "shipped", "shipping event", "shipping events", "ships", "will have sent", "will have shipped", "will send", "will ship"]

Shipping of objects from one physical location to another. Shipping from the perspective of being done as a dedicated service, such as what UPS, the US Postal Service, or Dominoes Pizza Delivery might do.

A Type of: delivery service, ride, transportation of materials

Instance of: temporal object type, transportation-topic, type of durative event

Subtypes:

Instances:

Wikipedia:

<http://en.wikipedia.org/wiki/Shipping>

Same as:

<http://www.w3.org/2006/03/wn/wn20/instances/synset-transport-verb-4>

<http://dbpedia.org/resource/Shipping>

<http://umbel.org/umbel/sc/Shipping>

<http://www.w3.org/2006/03/wn/wn20/instances/synset-transportation-noun-5>

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ally
a

Cycorp, Inc.



Search at sw.opencyc.org

OpenCyc (Current): [<http://sw.opencyc.org/concept/Mx4rvXjYl5wpEbGdrcN5Y29ycA>]

OpenCyc (Versioned): [<http://sw.opencyc.org/2008/06/10/concept/Mx4rvXjYl5wpEbGdrcN5Y29ycA>]

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OpenCyc Collection: toll route

Unique ID: [[Mx4rvXjYl5wpEbGdrcN5Y29ycA](http://sw.opencyc.org/concept/Mx4rvXjYl5wpEbGdrcN5Y29ycA)]

English ID: [[TollPathway](#)]

English Aliases: ["toll pathway", "toll pathways", "toll routes", "toll-road", "toll-roads"]

A collection; a specialization of [Path_Customary](#). An instance of [TollPathway](#) is a path for the privilege of traversing which a fee must be paid.

A Type of: [route](#)

Instance of: [type of object](#), [type of temporally stuff-like thing](#)

Subtypes:

Instances:

Same as:

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Search at sw.opencyc.org

OpenCyc (Current): [<http://sw.opencyc.org/concept/Mx4rvXjYl5wpEbGdrcN5Y29ycA>]

OpenCyc (Versioned): [<http://sw.opencyc.org/2008/06/10/concept/Mx4rvXjYl5wpEbGdrcN5Y29ycA>]

OpenCyc (Current): [<http://sw.opencyc.org/concept/Mx8Ngh4rv3tMrJwpEbGdrcN5Y29ycB4rvVizgZwpEbGdrcN5Y29ycA>]

OpenCyc (Versioned): [<http://sw.opencyc.org/2008/06/10/concept/Mx8Ngh4rv3tMrJwpEbGdrcN5Y29ycB4rvVizgZwpEbGdrcN5Y29ycA>]



OpenCyc Collection: truck driving

Unique ID: [[Mx8Ngh4rv3tMrJwpEbGdrcN5Y29ycB4rvVizgZwpEbGdrcN5Y29ycA](http://sw.opencyc.org/concept/Mx8Ngh4rv3tMrJwpEbGdrcN5Y29ycB4rvVizgZwpEbGdrcN5Y29ycA)]

English ID: [(TransportViaFn Truck)]

English Aliases: ["had trucked", "has trucked", "have trucked", "transportation by means of trucks", "truck", "trucked", "trucking", "trucks", "will have trucked", "will truck"]

A Type of: motoring

Instance of: skilled activity, type of vehicle classified by intended use

Subtypes:

Instances:

Same as:

<http://www.w3.org/2006/03/wn/wn20/instances/synset-truck-verb-1>

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Search at sw.opencyc.org

OpenCyc (Current): [<http://sw.opencyc.org/concept/Mx4rSbwOlPpYEdqAAAACs71DGQ>]

OpenCyc (Versioned): [<http://sw.opencyc.org/2008/06/10/concept/Mx4rSbwOlPpYEdqAAAACs71DGQ>]

Search



OpenCyc Collection: loading a vehicle

Unique ID: [[Mx4rSbwOlPpYEdqAAAACs71DGQ](#)]

English ID: [[LoadingAVehicle](#)]

English Aliases: ["had loaded a vehicle", "has loaded a vehicle", "have loaded a vehicle", "load a vehicle", "loaded a vehicle", "loads a vehicle", "will have loaded a vehicle", "will load a vehicle"]

The collection of instances of [Loading](#) in which the [toLocation](#) is a vehicle.

A Type of: [loading](#), putting something into something else

Instance of: type of temporally stuff-like thing

Subtypes:

Instances:

Same as:

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Inferred Index

order by : [predicate](#) [ontology](#)
filters : [predicate](#) [ontology](#)
index view : [inferred](#) [legal](#)

for
[Shipping](#)

[Browsing](#) [Editing](#)

[All Assertions](#) (2640) [open all](#)

- via [Shipping](#) (46)
- via [ConveyingMaterials](#) (4)
- via [\(TransportViaFn TransportationDevice\)](#) (22)
- via [MaterialHandling](#) (5)
- via [TransportationEvent](#) (33)
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- via [Translation-Complete](#) (5)
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- via [Translation-SingleTrajectory](#) (9)
- via [ControllingAPhysicalDevice](#) (5)
- via [Movement-TranslationEvent](#) (19)
- via [ControllingSomething](#) (4)
- via [ServiceEvent](#) (11)
- via [Translocation](#) (7)
- via [HelpingAnAgent](#) (3)
- via [MovementEvent](#) (7)
- via [MovementOrShapeChangeEvent](#) (19)
- via [GeneralizedTransfer](#) (8)
- via [HumanActivity](#) (5)
- via [PurposefulPhysicalAction](#)
- via [ActionOnObject](#) (5)
- via [AnimalActivity](#) (8)
- via [AnimateActivity](#) (9)
- via [IntelligentAgentActivity](#) (3)
- via [SocialOccurrence](#) (11)
- via [PhysicalEvent](#) (9)

Collection : [Shipping](#) [+]

on the term

[isa](#) : [DurativeEventType](#) [TemporalObjectType](#)

[isa](#) : [Transportation-Topic](#)

[quotedIsa](#) : [DensoOntologyConstant](#)

[quotedIsa](#) : [ResearchCycConstant-EventTypeOKWRTRoles](#) [PublicConstant](#) [CycSecureFORT](#)

[genls](#) : [\(TransportViaFn TransportationDevice\)](#) [ConveyingMaterials](#) [DeliveryServiceEvent](#)

[comment](#) : "Shipping of objects from one physical location to another. Shipping from the perspective of being done as a dedicated service, such as what UPS, the US Postal Service, or Dominoes Pizza Delivery might do."

[cycSubjectClumps](#) : [Transportation-CSC](#)

[genStringAssertion](#) : [M\(verbSemTrans-Canonical Ship-TheWord 0 IntransitiveVerbFrame Shipping \(TheList transportees\)\)](#)

[M\(verbSemTrans-Canonical Ship-TheWord 0 TransitiveNPFrame Shipping \(TheList performedBy transportees\)\)](#)

[genStringAssertion](#) : [M\(denotation Ship-TheWord Verb 0 Shipping\)](#)

[inTopic](#) : [Transportation-Topic](#)

[\(nonDavidsonianPredTemplate Shipping TransitiveNPFrame \(TheList performedBy primaryObjectMoving\)](#)

[\(and](#)

[\(isa :ACTION Shipping\)](#)

[\(performedBy :ACTION :SUBJECT\)](#)

[\(primaryObjectMoving :ACTION :OBJECT\)\)\)](#)

[\(nonDavidsonianPredTemplate Shipping TransitiveNPFrame \(TheList performedBy transportees\)](#)

[\(and](#)

[\(isa :ACTION Shipping\)](#)

[\(performedBy :ACTION :SUBJECT\)](#)

[\(transportees :ACTION :OBJECT\)\)\)](#)

[\(nonDavidsonianPredTemplate Shipping IntransitiveVerbFrame \(TheList transportees\)](#)

[\(and](#)

[\(isa :ACTION Shipping\)](#)

Detailed Representations

Inferred Index

for

Shipping

order by : [predicate](#) ontolo
filters : [predicate](#) ontolo
index view : [inferred](#) lega

▶ [Browsing](#) ▶ [Editing](#)

[All Assertions](#) (2640) ▶ [open all](#)

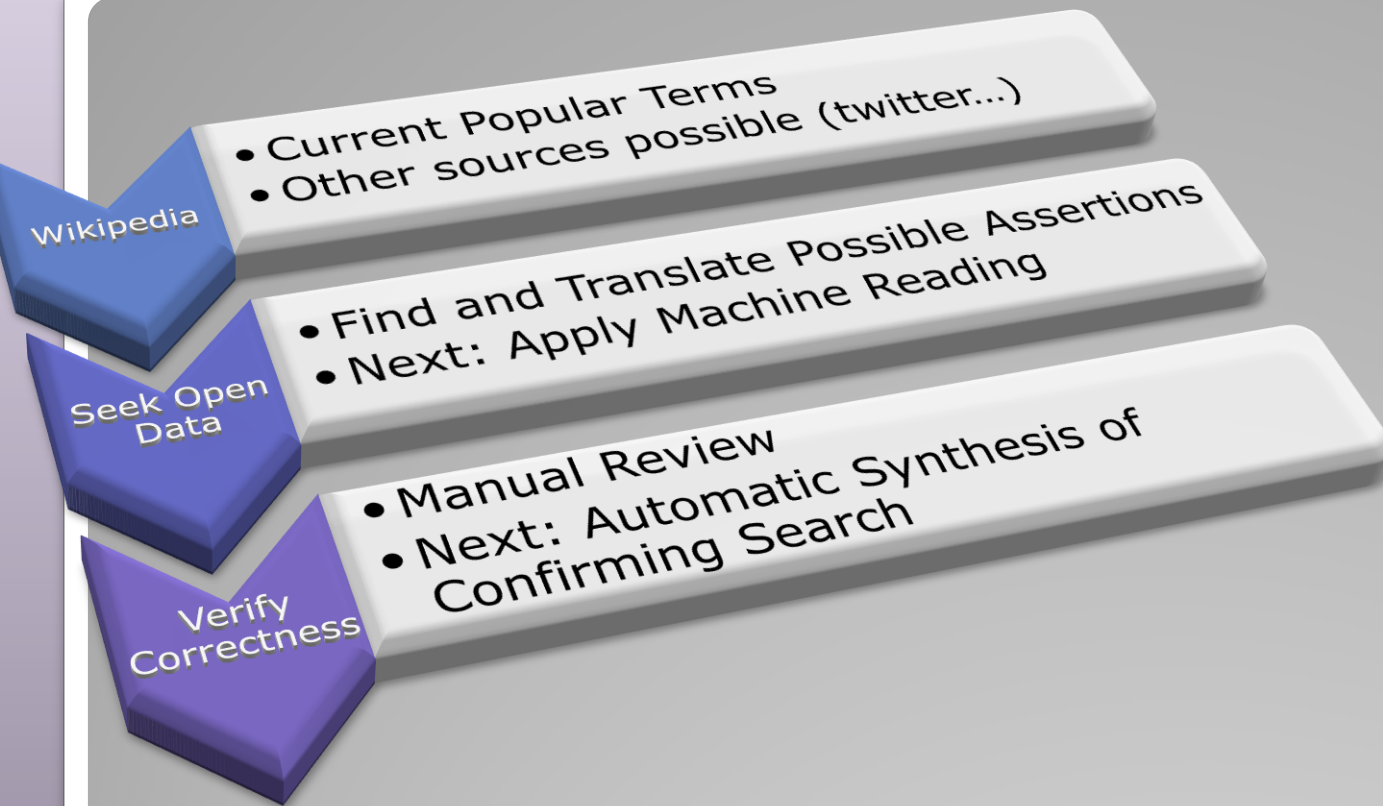
- ▶ via [Shipping](#) (46)
- ▶ via [ConveyingMaterials](#) (4)
- ▶ via [\(TransportViaFn TransportationDevice\)](#) (22)
- ▶ via [MaterialHandling](#) (5)
- ▶ via [TransportationEvent](#) (33)
- ▶ via [DirectedTranslation](#) (14)
- ▶ via [Conveying-Generic](#) (27)
- ▶ via [Translation-Complete](#) (5)
- ▶ via [CausingAnotherObjectsTranslationalMotion](#) (
- ▶ via [Translation-SingleTrajectory](#) (9)
- ▶ via [ControllingAPhysicalDevice](#) (5)
- ▶ via [SocialOccurrence](#) (11)
- ▶ via [PhysicalEvent](#) (9)

C

on

PublicConstant CvcSecureFORT
ConveyingMaterials DeliveryServiceEvent
physical location to another. Shipping from the perspective of being done
UPS, the US Postal Service, or Dominoes Pizza Delivery might do."
Canonical Ship-TheWord 0 IntransitiveVerbFrame Shipping
Canonical Ship-TheWord 0 TransitiveNPFrame Shipping
By transportees))
TheWord Verb 0 Shipping)
TransitiveNPFrame
ing)
cy
ge
ECT)))
TransitiveNPFrame
ge
TransitiveVerbFrame

Detailed Representations



840 terms
learned in
3 weeks



Automatic Term Learning

Individual : Franco-PrussianWar ^[+]

on the term

isa : ● [TemporalThing](#)

isa : ● [MilitaryConflictEvent](#)

● [\(codeMapping DBpedia-CMLS "<http://dbpedia.org/reso](#)

definiteDescriptions : ● [M](#)"the Franco-Prussian War"

nameString : ● [M](#)»[Ranskan-Preussin sota](#)

nameString : ● [M](#)"Guerre franco-allemande (1870)"

nameString : ● [M](#)»[Deutsch-Französischer Krieg](#)

nameString : ● [M](#)"Guerra franco-prussiana"

nameString : ● [M](#)»[普法戰爭](#)

nameString : ● [M](#)"Frans-Duitse Oorlog"

nameString : ● [M](#)»[普仏戦争](#)

nameString : ● [M](#)"Den fransk-preussiske krig"

nameString : ● [M](#)"Wojna francusko-pruska"

nameString : ● [M](#)"Guerra franco-prussiana"

nameString : ● [M](#)»[Франко-прусская война 1870—1871](#)

nameString : ● [M](#)"Guerra Franco-Prusiana"

nameString : ● [M](#)"Fransk-tyska kriget"

rdfURI : ● ["http://dbpedia.org/resource/Franco-Prussian_War"](#)

● [\(rdfURInNamespace Franco-PrussianWar DBpediaReso](#)

wikipediaArticleName : ● [M](#)"Franco-Prussian_War"

\$Warehouse13-TelevisionSeries
\$RyanReynolds-TheActor
\$DonRevie-SoccerCoach
\$BridgetPowers-ActorThatIsAlsoAnAdult
\$TheSuiteLifeOnDeck-TelevisionSeries
\$ChelseaFC
\$StormingOfTheBastille
\$TheColoradoKid-Book
\$EmileHeskey-SoccerPlayer
\$TravisWall-Person
\$BeezusAndRamona-Book
\$UFC116
\$CherylCole-TheMusician
\$JamesGammon-Actor
\$EdMiliband-ThePolitician
\$GeorgeSteinbrenner-FamousPerson
\$AleksandarKolarov-SoccerPlayer
\$SonsOfAnarchy-TelevisionSeries
\$ScottPilgrimVsTheWorld-Movie
\$PrettyLittleLiars-Book
\$VicenteDelBosque-SoccerCoach
\$MakeItOrBreakIt-TelevisionSeries
\$Adderall

3 weeks



Automatic T

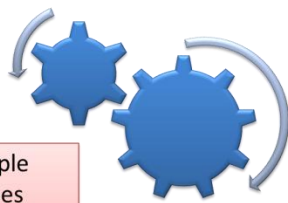


Reasoning from Triple Store Data

Queries

English or SPARQL

What media might reach European Space Agency executives?



Answer:
Le Monde
Le Figaro

Knowledge from triple store answers queries after being combined with existing knowledge and inference rules.

newspaperInCity(Le Monde, Paris)
(newspaperInCity-SKSI
(ResourceWithURIFn
"http://www.cyc.com/external/MR/CMUReadTheWebOntology/Le%20Monde")
CityOfParisFrance)

Triples translated into CycL using translation rules

```
(graphes
 (hasHeadquartersInRegion ?ORG ?PLACE)
 (nrHasHeadquartersInRegion ?ORG ?PLACE))
(graphes
 (and
  (nrExternalRelation ?BNODE nrHasHeadquartersInRegion)
  (nrExternalArg1 ?BNODE ?ARG1)
  (nrExternalArg2 ?BNODE ?ARG2))
 (nrHasHeadquartersInRegion ?ARG1 ?ARG2))
```

Shared Knowledge Store

```
newspaperincity 52 103 newspaperincity(Le Monde, Paris)
__b196763 <http://www.cyc.com/external/MR/arg1> <http://www.cyc.com/external/MR/CMUReadTheWebOntology/Le%20Monde> .
__b196763 <http://www.cyc.com/external/MR/relation> <http://sw.opencyc.org/concept/Mx4rWgSinqEd-ViQAhmOkILA> .
__b196763 <http://www.cyc.com/external/MR/arg2> <http://sw.opencyc.org/concept/Mx4rVj5JwpEbGdrcN5Y29ycA> .
__b196763 <http://www.cyc.com/external/MR/graphName> " <http://www.cyc.com/external/MR/ambiguous> " .

headquarteredin 8 34 headquarteredin(NASA, Houston)
__b40562 <http://www.cyc.com/external/MR/arg1> <http://www.cyc.com/external/MR/CMUReadTheWebOntology/NASA> .
__b40562 <http://www.cyc.com/external/MR/relation> <http://sw.opencyc.org/concept/Mx4rcVzZjBpEd-ViQAhmOkILA> .
__b40562 <http://www.cyc.com/external/MR/arg2> <http://sw.opencyc.org/concept/Mx4rVj5JwpEbGdrcN5Y29ycA> .
__b40562 <http://www.cyc.com/external/MR/graphName> " <http://www.cyc.com/external/MR/ambiguous> " .

headquarteredin 37 132 headquarteredin(NASA, Washington)
__b55317 <http://www.cyc.com/external/MR/arg1> <http://www.cyc.com/external/MR/CMUReadTheWebOntology/NASA> .
__b55317 <http://www.cyc.com/external/MR/relation> <http://sw.opencyc.org/concept/Mx4rVgR7mCgEd-ViQAhmOkILA> .
__b55317 <http://www.cyc.com/external/MR/arg2> <http://sw.opencyc.org/concept/Mx8Ngx4rVhWppwEbGdrcN5Y29ycA> .
__b55317 <http://www.cyc.com/external/MR/graphName> " <http://www.cyc.com/external/MR/ambiguous> " .

newspaperincity 19 39 newspaperincity(Washington Times, Washington)
__b78640 <http://www.cyc.com/external/MR/arg1> <http://sw.opencyc.org/concept/Mx4r5oK-mhIAQdiYEfsxTW1S_Q> .
__b78640 <http://www.cyc.com/external/MR/relation> <http://sw.opencyc.org/concept/Mx4rVgSinqEd-ViQAhmOkILA> .
__b78640 <http://www.cyc.com/external/MR/arg2> <http://sw.opencyc.org/concept/Mx8Ngx4rVhWppwEbGdrcN5Y29ycA> .
__b78640 <http://www.cyc.com/external/MR/graphName> " <http://www.cyc.com/external/MR/ambiguous> " .
__b78640 <http://www.cyc.com/external/MR/arg1> <http://sw.opencyc.org/concept/Mx4r5oK-mhIAQdiYEfsxTW1S_Q> .
__b78640 <http://www.cyc.com/external/MR/relation> <http://sw.opencyc.org/concept/Mx4rVgSinqEd-ViQAhmOkILA> .
__b78640 <http://www.cyc.com/external/MR/arg2> <http://sw.opencyc.org/concept/Mx4rVhWppwEbGdrcN5Y29ycA> .
__b78640 <http://www.cyc.com/external/MR/graphName> " <http://www.cyc.com/external/MR/ambiguous> " .
```

BigOWLIM Triple Store

Shared representation of reading results stored in triple store.

EuropeanSpaceAgency

Monadic Mt : [WorldGeographyMt](#)
Time Interval : [\(TimeIntervalInclusiveFn \(YearFn 1975\) Now\)](#)
Time Parameter : [TimePoint](#)
isa : [PublicSectorSpaceAgency](#) [InternationalOrganizationOfCountries](#)
hasHeadquartersInRegion : [CityOfParisFrance](#)
internationalOrganizationMemberCountries :

- [Belgium](#) [Germany](#) [Denmark](#) [France](#)
- [UnitedKingdomOfGreatBritainAndNorthernIreland](#) [Italy](#) [Netherlands](#)
- [Sweden](#) [Switzerland](#) [Spain](#)

[wikipediaArticleName](#) : ["European_Space_Agency"](#)
Mt : [EnglishMt](#)
nameString : ["European Space Agency"](#)
initialismString : ["ESA"](#)

Other Knowledge
Existing knowledge from Cyc KB or other external sources is combined with read knowledge to answer questions.



The Mississippi River

General:

[The Arkansas River](#), [the Red River](#), [the Ohio River](#), [the Tennessee River](#), [the Missouri River](#), [the St. Francis River](#), and [the Wisconsin River](#) are a tributary of the Mississippi River.

The Mississippi River is a large body of water and a [river](#).

The Mississippi River is in [North America](#) and the United States. The Mississippi River is in [the United States](#).

The Mississippi River empties into the Gulf of Mexico. The Mississippi River borders on St. Louis, MO.

Miscellaneous:

Comment: The chief river of the North American Continent and one of the worlds great rivers. The Mississippi River generally moves due south. It temporally contains the time period between 5001 B.C. and the Twenty-First Century A.D. [Mississippi](#) is named after the Mississippi River.

The Mississippi River has been adjacent to Louisiana State Penitentiary since 1880.

[How was this page created?](#)

The Mississippi River

General:

[The Arkansas River](#), [the Red River](#), [the Ohio River](#), [the Tennessee River](#), [the Missouri River](#), [the St. Francis River](#), and [the Wisconsin River](#) are a tributary of the Mississippi River.

The Mississippi River is

The Mississippi River is
[States](#).

The Mississippi River e

Miscellaneous:

Comment: The chief riv
Mississippi River gener
the Twenty-First Centu
The Mississippi River h

Basic:

Carbon is a type of non-metallic element.

Documentation:

Comment: A piece of carbon; here on Earth, this is of course usually a solid, but it needn't necessarily be.

Structure:

Some carbon is a constituent of all steel and all [gunpowder](#).

Every [organic compound](#) has some carbon as a proper physical part.

Miscellaneous:

A diamond, wood coal, and graphite are a type of carbon.

A possible valence of carbon is 4 and -4.

4 and 2 are possible oxidation numbers for carbon.

The atomic number of carbon is 6.

The atomic weight of carbon is 12.0107 atomic mass units. Every carbon metabolic event destroyed some carbon.
Carbon 14 is isotopes of carbon.



The Mississippi River

General:

[The Arkansas River](#), [the Red River](#), [the Ohio River](#), [the Tennessee River](#), [the Missouri River](#), [the St. Francis River](#), and [the Wisconsin River](#) are a tributary of the Mississippi River.

The Mississippi River is

The Mississippi River is

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The Roman Empire

Documentation:

Comment: The geopolitical entity known as the Roman Empire (27 BC -- 476 AD).

General:

The Roman Empire is an [empire](#). The capital city of it was [Rome, Italy](#). [Lusitania](#) is part of The Roman Empire.

Affiliations:

[Lusitania](#) is part of The Roman Empire.

Every ancient Roman is a citizen of The Roman Empire.

The capital city of The Roman Empire was [Rome, Italy](#).

Miscellaneous:

Emperor Augustus is a citizen of The Roman Empire. The concept "[Jesus of Nazareth](#)" is conceptually related to the concept "The Roman Empire". It was made in all object of art from The Roman Empire. It ended in 476.

[How was this page created?](#)

be.

some carbon.



Slovenia



General:

[Ljubljana, Slovenia](#), [Koper, Slovenia](#), [Ljubljana, Slovenia](#), [Portoroz, Slovenia](#), and [Maribor, Slovenia](#) are in [Slovenia](#).

[Slovenia](#) borders on [Italy](#), [Croatia](#), [Hungary](#), and [Austria](#). [Slovenia](#) is northwest of [Croatia](#).

[Brezovica](#) is a geopolitical subdivision of [Slovenia](#). [Slovenia](#) has been a geopolitical subdivision of [the European Union](#) since the beginning of May 2004. [Bohinj](#) is a geopolitical subdivision of [Slovenia](#). [Bohinj](#) and [Brezovica](#) are a geographical subregion of [Slovenia](#).

[Slovenia](#) is an elected member of the Security Council, a Balkan country, and an [eastern European country](#).

- [Italy](#) is west of [Slovenia](#).
- [Slovenia](#) is west of [Hungary](#).

[Slovenia](#) is northeast of [Italy](#). The capital city of it is [Ljubljana](#). [Slovenia](#) is south of [Austria](#). [Slovenia](#) was a geopolitical subdivision of [Yugoslavia](#) after 1922 and before 1992.

Group Membership:

[Slovenia](#) is a member of [the United Nations](#).

Affiliations:

[Maribor, Slovenia](#), [Koper, Slovenia](#), [Ljubljana, Slovenia](#), [Portoroz, Slovenia](#), and [Ljubljana, Slovenia](#) are in [Slovenia](#).

- [Brezovica](#) and [Bohinj](#) are a geopolitical subdivision of [Slovenia](#).
- [Slovenia](#) has been a geopolitical subdivision of [the European Union](#) since the beginning of May 2004.
- [Slovenia](#) was a geopolitical subdivision of [Yugoslavia](#) after 1922 and before 1992.

The capital city of [Slovenia](#) is [Ljubljana](#). [Slovenia](#) is a member of [the United Nations](#).

Miscellaneous:



[Slovenia](#) is inhabited by many Croats, Slovenes, and Serbians.

[Slovenian](#) is among the national languages of [Slovenia](#). The concept "[Slovenian](#)" is conceptually related to the concept "[Slovenia](#)".

[Slovenia](#)'s telephone country code is 386. Muslim people are one of the primary types of people inhabiting [Slovenia](#). [Slovenia](#) is obliged to follow the Universal Declaration of Human Rights. [Slovenia](#) bought goods or services from [Algeria](#) in 1997.

From 1998 or earlier to at least November 1999, [Slovenia](#) was an elected member of [the Security Council](#). [Slovenia](#) was an elected member of the Security Council after 1997 and before December 31, 1999.

[How was this page created?](#)

 is the head of the United Arab Emirates. 



inCyc^{beta}

The United Arab Emirates



BASIC DATA		
PREDICATE	VALUE	DATE RANGE
Chief Ports	Dubai	always
Capital city	Abu Dhabi, the United Arab Emirates	always
Land Area Of Region	75,581 square kilometers	always
Predominant Language	Arabic	always
Government Type	federation government	always
Neighbor	Saudi Arabia	
Neighbor	Oman	
Neighbor	Qatar	

Abu Dhabi, Dubai, Ajman, Sharjah, [Dubai](#), Ras al Khaymah, and [al fujayrah](#) are in the United Arab Emirates.
The United Arab Emirates is south of [the Tumbs Islands](#), [Qatar](#), [Das Island](#), [Abu Musa](#), and [Qeshm](#). The United Arab

[How was this page created?](#)

person is the head of the United Arab Emirates.

General
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The Missi
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Misce
Emperc
concept

South Korea



BASIC DATA		
PREDICATE	VALUE	DATE RANGE
Predominant Language	the Korean language	always
Neighbor	North Korea	always
Capital city	Seoul, the Republic of Korea	always

[Pusan, Korea, Republic of](#), [Taegu-jikhalsi, Korea, Republic of](#), [Kunsan, Korea, Republic of](#), [Seoul, Korea, Republic of](#), [Mokpo, Korea, Republic of](#), [Ulsan, Korea, Republic of](#), [Inchon, Korea, Republic of](#), and 3 other cities in South Korea are in South Korea.

South Korea is an elected member of the Security Council, an [independent country](#), an industrialized country, and an [East Asian country](#).


- South Korea is west of [Japan](#).
- [China](#) is west of South Korea.

[How was this page created?](#)

Seoul, the Republic of Korea


Seoul, Korea, Republic of is a [city in South Korea](#) and a [capital](#).
Seoul is the capital of [South Korea](#). Seoul, Korea, Republic of is in [South Korea](#).
Seoul, Korea, Republic of's latitude is 37.56639862060547 degrees. Seoul, Korea, Republic of's longitude is 127 degrees.

Miscellaneous

Some subway is located in Seoul, Korea, Republic of. In 1994, Seoul, Korea, Republic of had a population of 9,204,344 people.  Seoul, Korea, Republic of's population was 9,204,344 in 1994.

Manually Written Notes

The #ScapitalCity of [SouthKorea](#).

 the CIA World Factbook: 1995 edition

Technical Details

This page was automatically created by Cyc using [automated reasoning and natural language processing](#). Cyc first learned about Seoul, the Republic of Korea on November 29, 1987. The [Semantic Web URI](#) for Seoul, the Republic of Korea is: <http://sw.opencyc.org/concept/Mx4rvVjXhJwpEbGdrcN5Y29ycA>

and an [East Asian country](#).

- South Korea is west of [Japan](#).
- [China](#) is west of South Korea.



Republic of, [Seoul, Korea, Republic of](#), and 3 industrialized country,

[How was this page created?](#)

Republic of the Congo



BASIC DATA


PREDICATE	VALUE	DATE RANGE
Predominant Language	French	always
Government Type	people's republic	always
Capital city	Brazzaville, Congo	always
Neighbor	Cameroon	always
Neighbor	Angola	
Neighbor	Gabon	
Neighbor	Democratic Republic of the Congo	
Neighbor	Central African Republic	

Miscellaneous

Some subwa
population of

Manually V

The #Scap

 the CIA

Technical

This page wa
Cyc first lear
for Seoul, the

- [Niari](#),
- [Pool](#),
- [Cuvette](#),
- [Plateaux](#),
- and [Brazzaville](#)

Misce

Abu Dhabi are in Republic of the Congo.

The United Ara

- [China](#) is west of South Korea.

How was this page created:

Facts and Rules (from 1998, 2003)

Mt : [InternationalOrganizationDataMt](#)
([internationalOrganizationMemberCountries](#)
[AfricanUnion](#) [Congo-Brazzaville](#))
([internationalOrganizationMemberCountries](#)
[UnitedNationsOrganization](#) [Congo-Brazzaville](#))

([implies](#) ([and](#)
([isa](#) ?COUNTRY [IndependentCountry](#))
([territoryOf](#) ?COUNTRY ?LAND)
([geographicalSubRegions](#) [ContinentOfAfrica](#)
?LAND))
([internationalOrganizationMemberCountries](#)
[OrganizationOfAfricanUnity](#) ?COUNTRY))

Republic of the Congo is a member of
Organization of African Unity, the
United Nations, and African Union.

Automated Reasoning

```
(implies (and
  (isa ?COUNTRY IndependentCountry)
  (territoryOf ?COUNTRY ?LAND)
  (geographicalSubRegions ContinentOfAfrica ?LAND)
  (internationalOrganizationMemberCountries
   OrganizationOfAfricanUnity ?COUNTRY)) in
  InternationalOrganizationDataMt
  (territoryOf Congo-Brazzaville
   TerritoryFn Congo-Brazzaville)) in
  WorldPoliticalGeographyDataVocabularyMt
  (properGeographicalSubRegions ContinentOfAfrica
   TerritoryFn Congo-Brazzaville)) in
  WorldGeographyMt :GENLPREDS (genlPreds
  properGeographicalSubRegions geographicalSubRegions)
  in InternationalOrganizationDataMt
  :ISA (isa Congo-Brazzaville IndependentCountry) in
  InternationalOrganizationDataMt
```



beta
Republic of the Congo
inCyc

General:
[Likouala](#), [Niari](#), [Kouilou](#), [Pool](#), and [Bouenza](#) are a geographical subregion of Republic of the Congo.
[Niari](#), [Kouilou](#), [Pool](#), [Bouenza](#), [Likouala](#), [Cuvette](#), [Plateaux](#), and 3 others are a geopolitical subdivision of Republic of the Congo.
[Brazzaville](#), [Cuvette](#), [Plateaux](#), [Sangha](#), and [Lekoumou](#) are a geographical subregion of Republic of the Congo.

- [Central African Republic](#)
◦ and [Democratic Republic of the Congo](#)
border on Republic of the Congo.
- Republic of the Congo borders on [Cameroon](#).
- [Gabon](#) and [Angola](#) border on Republic of the Congo.

Republic of the Congo is an [African country](#), a [people's republic](#), and a [republic](#).

- Republic of the Congo is east of [Gabon](#).
- [Democratic Republic of the Congo](#) is east of Republic of the Congo.

Knowledge for People

People

- ([isa occupation BioDataPredicate](#))
- ([isa dateOfDeathEvent BioDataPredicate](#))
- ([isa placeOfDeath BioDataPredicate](#))
- ([isa citizens BioDataPredicate](#))
- ([isa ethnicity BioDataPredicate](#))
- ([isa birthPlace BioDataPredicate](#))
- ([isa dateOfDeath BioDataPredicate](#))
- ([isa birthDate BioDataPredicate](#))

Agent Location

Mt : [BaseKB](#)

Direction : Backward

- [M\(implies](#)
 - ([and](#)
 - ([genlPreds ?SPEC \[hasBeenIn\]\(#\)](#))
 - ([ist-Asserted ?MT](#)
(?SPEC ?ARG1 ?ARG2)))
 - ([agentLocationDataSentence ?ARG1](#)
([ist ?MT](#)
(?SPEC ?ARG1 ?ARG2))))

Agent Affiliation

- [M\(implies](#)
 - ([and](#)
 - ([genlPreds ?SPEC \[affiliatedWith\]\(#\)](#))
 - ([ist-Asserted ?MT](#)
(?SPEC ?ARG1 ?ARG2)))
 - ([agentAffiliationDataSentence ?ARG2](#)
([ist ?MT](#)
(?SPEC ?ARG1 ?ARG2))))
- [M\(implies](#)
 - ([and](#)
 - ([genlPreds ?SPEC \[affiliatedWith\]\(#\)](#))
 - ([ist-Asserted ?MT](#)
(?SPEC ?ARG1 ?ARG2)))
 - ([agentAffiliationDataSentence ?ARG1](#)
([ist ?MT](#)
(?SPEC ?ARG1 ?ARG2))))

What goes on a inCyc Page?

InCyc HTML Production Rules

- M(implies
(and
(isa ?PRED BasicDataPredicate)
(miniFactSheetFlagHtml ?TOPIC ?FLAG-IMAGE-HTML)
(?PRED ?TOPIC ?DATA)
(evaluate ?FLAG-DATUM
(HTMLTableDataFn
(TheList
(TheList Rowspan-HTMLTagAttribute 3)) ?FLAG-IMAGE-HTML))
(evaluate ?ROW
(HTMLTableRowFn TheEmptyList ?FLAG-DATUM ?ROW1))
(evaluate ?ROW1
(HTMLTableDataFn TheEmptyList
(BasicDatumParaphraseFn
(NthInListFn ?DATA 1) ?MT)))
(evaluate ?ROW2
(HTMLTableRowFn TheEmptyList
(HTMLTableDataFn TheEmptyList
(BasicDatumParaphraseFn
(NthInListFn ?DATA 2) ?MT))))
(evaluate ?ROW3
(HTMLTableRowFn TheEmptyList
(HTMLTableDataFn TheEmptyList
(BasicDatumParaphraseFn
(NthInListFn ?DATA 3) ?MT))))
(evaluate ?TABLE
(HTMLTableFn TheEmptyList ?ROW ?ROW2 ?ROW3)))
(basicDataHTML ?TOPIC ?MT ?TABLE))

Use case – systems biology

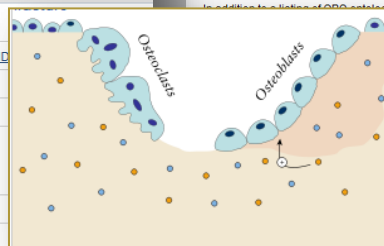


View Ontology Summary Details Visualization Notes (0) Mappings (8) Resource Index

Jump To: [Legend](#)

- Metabolism and nutrition disorders
- Musculoskeletal and connective tissue disorders
 - Bone disorders (excl congenital and fractures)
 - Bone and joint infections (excl arthritis)
 - Bone disorders NEC
 - Bone related signs and symptoms
 - Epiphyseal disorders
 - Metabolic bone disorders
 - Bone atrophy
 - Bone metabolism disorder
 - Dwarfism
 - High turnover osteopathy
 - Hungry bone syndrome
 - Low turnover osteopathy
 - Osteodystrophy
 - Osteolysis
 - Osteomalacia
 - Osteopenia
 - Osteoporosis
 - Osteoporosis circumscripta cranii
 - Osteoporosis postmenopausal**
 - Renal osteodystrophy
 - Renal rickets
 - Resorption bone increased
 - Rickets
 - Senile osteoporosis
- Connective tissue disorders (excl congenital)

ID: 10031285
 Full Id: <http://purl.bioontology.org/ontology/MD>
 Synonyms: Osteoporosis postmenopausal
 Mps: 10028395
 Par: [Bone metabolism disorders](#)
[Menopausal effects NEC](#)
[Metabolic bone disorders](#)
 Rq: [Osteoporosis postmenopausal](#)
 Semantic Type: Disease or Syndrome
 Synonym Lt: Osteoporosis postmenopausal
 Tui: T047
 Umls Cui: C0029458



Hippocampus CA1 ivy neuron

BASIC **ADVANCED** **FACTBOX**

NEURO LEX THE NEUROSCIENCE LEXICON

Name: Hippocampus CA1 ivy neuron

Ivy cells are highly abundant GABAergic interneurons when compared to basket, bistratified, or axo-axonic cells. Ivy cells are named after their dense and fine axons innervating mostly basal and oblique pyramidal cell dendrites. They express nitric oxide synthase, neuropeptide Y, and they are also identified as slow-excitability of pyramidal cell dendrites.

(S) CA1 ivy cell, ivy cell
 (S) Intrinsic neuron role
 (S) neuron
 (S) Fuentelba P et al., 2008
 (S) 18367092
 (S) nlx_35220
 (S) Download this content as OWL/RDF

Specific Properties
 CA1 alveus, CA1 stratum oriens, CA1 stratum radiatum, CA1 stratum moleculare, CA1 stratum oriens, CA1 stratum radiatum, CA1 stratum moleculare, CA1 stratum oriens, CA1 stratum radiatum, CA1 stratum moleculare

Specific Properties
 CA1 alveus, CA1 stratum oriens, CA1 stratum radiatum, CA1 stratum moleculare, CA1 stratum oriens, CA1 stratum radiatum, CA1 stratum moleculare

Transmitter: GABA

The OBO Foundry is a collaborative experiment involving developers of science-based ontologies who are establishing a set of principles for ontology development with the goal of creating a suite of orthogonal interoperable reference ontologies in the biomedical domain. The groups developing ontologies who have expressed an interest in this goal are listed below, followed by other relevant efforts in this domain. This site also provides a statement of the OBO Foundry principles, discussion form, technical glossary, and a list of participating ontologies. We welcome feedback and encourage participation. This site also provides a statement of the OBO Foundry principles, discussion form, technical glossary, and a list of participating ontologies. We welcome feedback and encourage participation. This site also provides a statement of the OBO Foundry principles, discussion form, technical glossary, and a list of participating ontologies. We welcome feedback and encourage participation.

OBO Foundry ontologies

Domain	Prefix	File	Last changed
biological process	GO	gene_ontology_edit.obo	2011/04/19
anatomy	GO	gene_ontology_edit.obo	2011/04/19
biochemistry	CHEBI	chebi.obo	2011/04/05
biological function	GO	gene_ontology_edit.obo	2011/04/19
phenotype	PATO	quality.obo	2011/04/18
proteins	PR	pro.obo	
anatomy	XAO	xenopus_anatomy.obo	2009/12/02
anatomy	ZFA	zebrafish_anatomy.obo	2011/03/16

OBO Foundry candidate ontologies and other ontologies of interest

Title	Domain	Prefix	File	Last changed
Adverse Event Reporting Ontology	health	AERO		
Amphibian gross anatomy	anatomy	AAO	amphibian_anatomy.obo	2008/06/19
Amphibian taxonomy	anatomy	ATO	amphibian_taxonomy.obo	
Anatomical Entity Ontology	anatomy	AEO	ase.obo	2011/01/17
Ascomycete phenotype ontology	phenotype	AP0	ascomycete_phenotype.obo	2011/03/28
Basic Formal Ontology	upper	BFO	1.1	
Bilateria anatomy	anatomy	BILA	bilateria_mrca.obo	
Biological imaging methods	experiments	FBi	image.obo	2010/09/29
BRENDA tissue / enzyme source	anatomy	BTO	BrendaTissueOBO	
C.elegans development	anatomy	WBLS	worm_development.obo	2008/01/31
	bmy	WBbt	WBbt.obo	2011/03/26
	bmy	WPPhenotype	worm_phenotype.obo	2011/03/30
	bmy	CL	cell.obo	2010/11/04
	bmy	TO	plant_trait.obo	2011/03/26
	chemistry	CHEMINF	cheminf.owl	
	bmy	CARO	caro.obo	2010/06/24

BMC Medical Genetics **2.64**

Genome-wide association with bone mass and geometry in the Framingham Heart Study

Douglas P Kiel, Serkalem Demissei, José Dupuis, Kathryn L Lunetta, Joanne M Hurabito, and David Karasik

1 Helmholtz Institute for Aging Research and Harvard Medical School, Boston, MA, USA
 2 Department of Biostatistics, Boston University School of Public Health, Boston, MA, USA
 3 Section of General Internal Medicine, Boston University School of Medicine, Boston, MA, USA
 4 The National Heart Lung and Blood Institute's Framingham Heart Study, Framingham, MA, USA

Published: 19 September 2007

Abstract

Background
 Osteoporosis is characterized by low bone mass and compromised bone structure, heritable traits that contribute to fracture risk. There have been no genome-wide association and linkage studies for these traits using high-density genotyping platforms.

Methods
 We used the Affymetrix 100K SNP GeneChip marker set in the Framingham Heart Study (FHS) to examine genetic associations with ten primary quantitative traits: bone mineral density (BMD), calcaneal ultrasound, and geometric indices of the hip. To test associations with multivariable-adjusted residual trait values, we used additive generalized estimating equation (GEE) and family-based association tests (FBAT) models within each sex as well as sexes combined. We evaluated 70,987 autosomal SNPs with genotypic call rates >80%, HWE $p \geq 0.001$, and MAF $\geq 10\%$ in up to 1141 phenotyped individuals (495 men and 646 women, mean age 62.5 yrs). Variance component linkage analysis was performed using 11,200 markers.

FRAMINGHAM HEART STUDY

A Project of the National Heart, Lung and Blood Institute and Boston University

About FHS Participants FHS Investigators Risk Score Profiles FHS Bibliography For Researchers

Welcome to the Framingham Heart Study

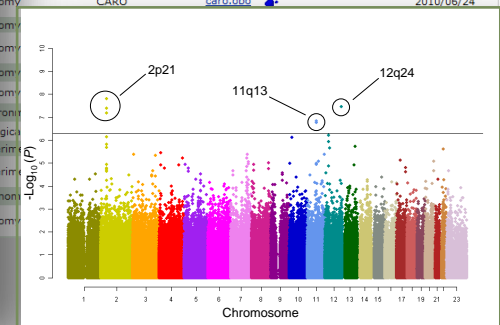
In 1948, the Framingham Heart Study embarked on an ambitious project in health research to identify the common factors that contribute to cardiovascular disease by following its development over a long period of time in a large group of participants.

Testing Treatments in a Tube: Induced Pluripotent Stem Cell Research (iPSC)

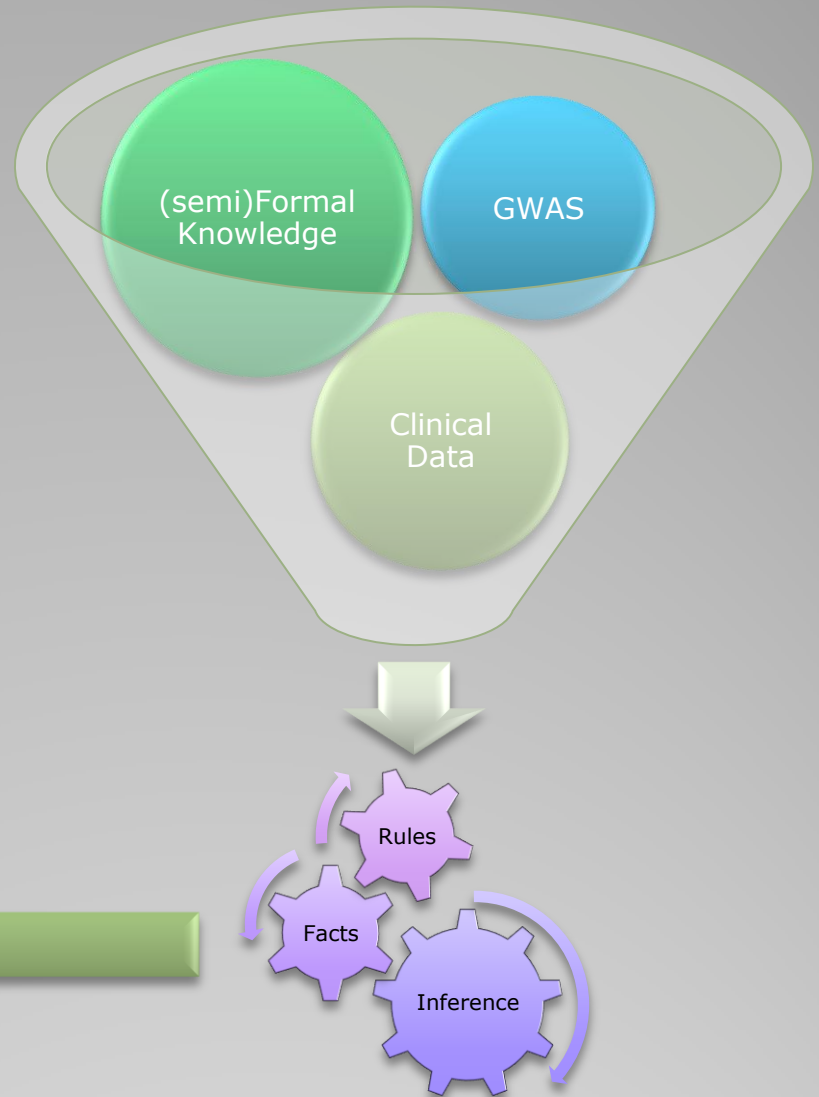
A recently developed method of changing ordinary white blood cells from individual blood samples so that they behave in the laboratory like cells from other organs. The first step reduces the specific functionality of the white cells, resulting in cells called iPSCs. The second step transforms the iPSC to imitate the function of another specific cell type such as liver, kidney or nerve cells. Since the iPSC testing is conducted in a laboratory after blood samples are drawn, the donor is not personally exposed to any tests with the stem of the Framingham Heart Study.

Philip Wolf, MD, Principal Investigator, and Dan Levy, MD, Director of treatments. MORE >>>

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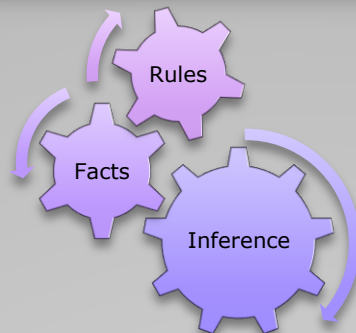
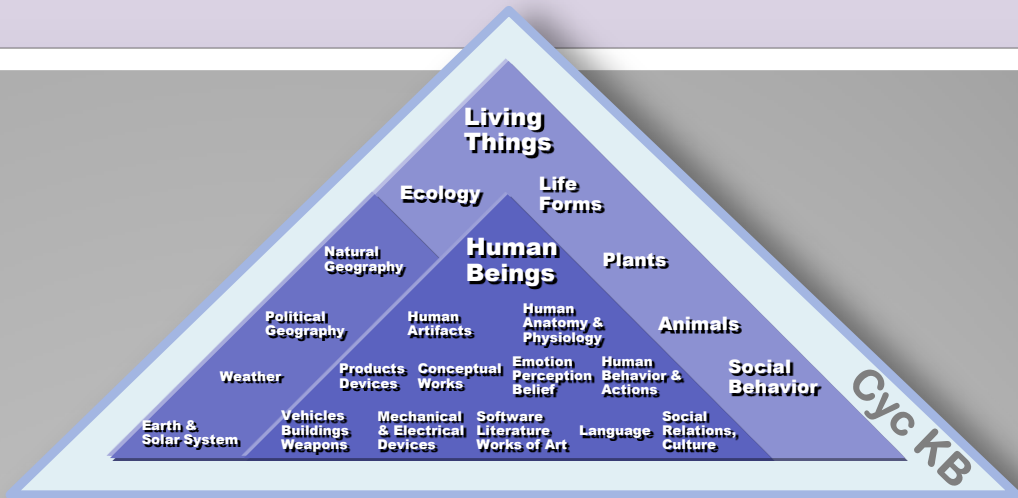
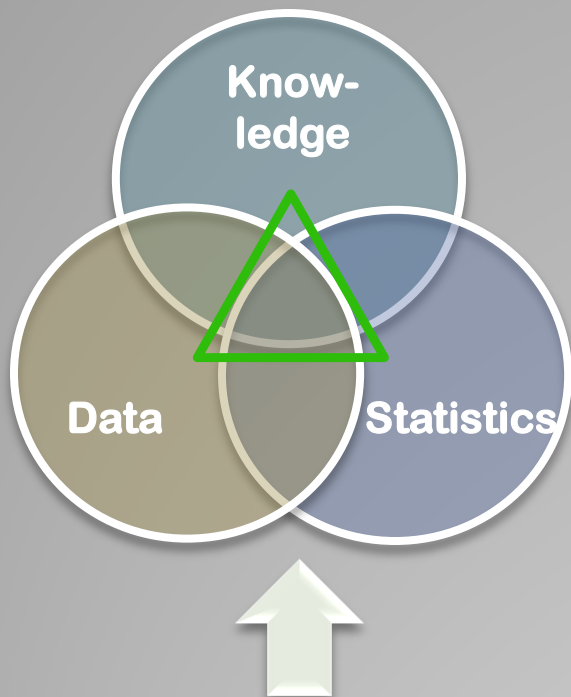
Overwhelming Biological Data



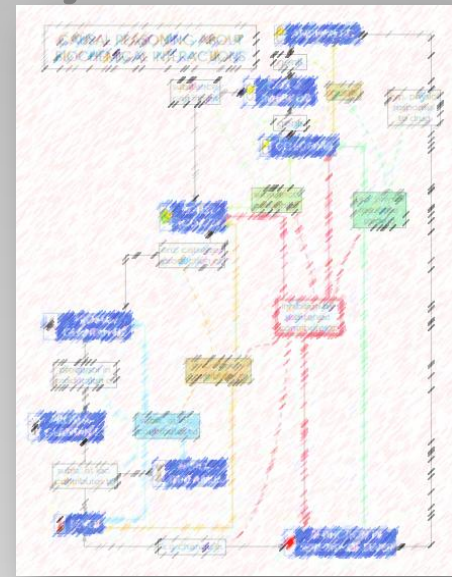
**Clinical or
Experimental
Hypotheses**



The Big Picture: AI assistance



Cyc Inference



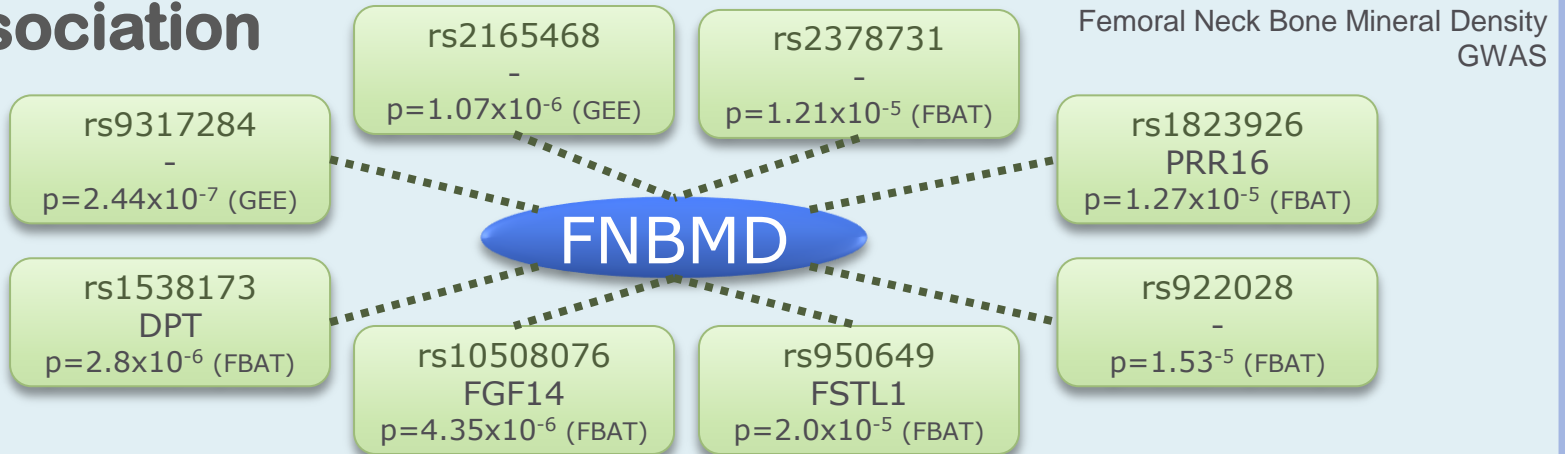
linked life data
 a semantic data integration platform for the biomedical domain

Focus: Osteoporosis and the Framingham Heart Study data



The Big Picture: AI assistance

Association



Douglas P Kiel, Serkalem Demissie, Josée Dupuis, Kathryn L Lunetta, Joanne M Murabito and David Karasik Genome-wide association with bone mass and geometry in the Framingham Heart Study *BMC Medical Genetics* 2007, 8(Suppl 1):S14

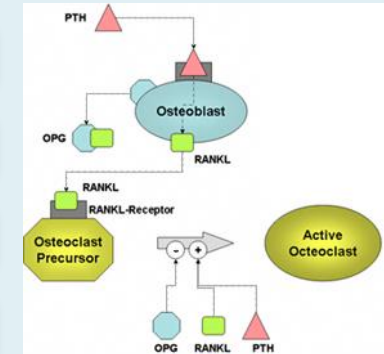
Weak Models



Strong Models

Knowledge of constraints, temporal and spatial ordering, temporal and physical parts, preconditions, consequences, rates, etc.

- Molecular interactions
- Receptors, ligands, etc.
- Cell types, stages
- Cell macro, micro processes



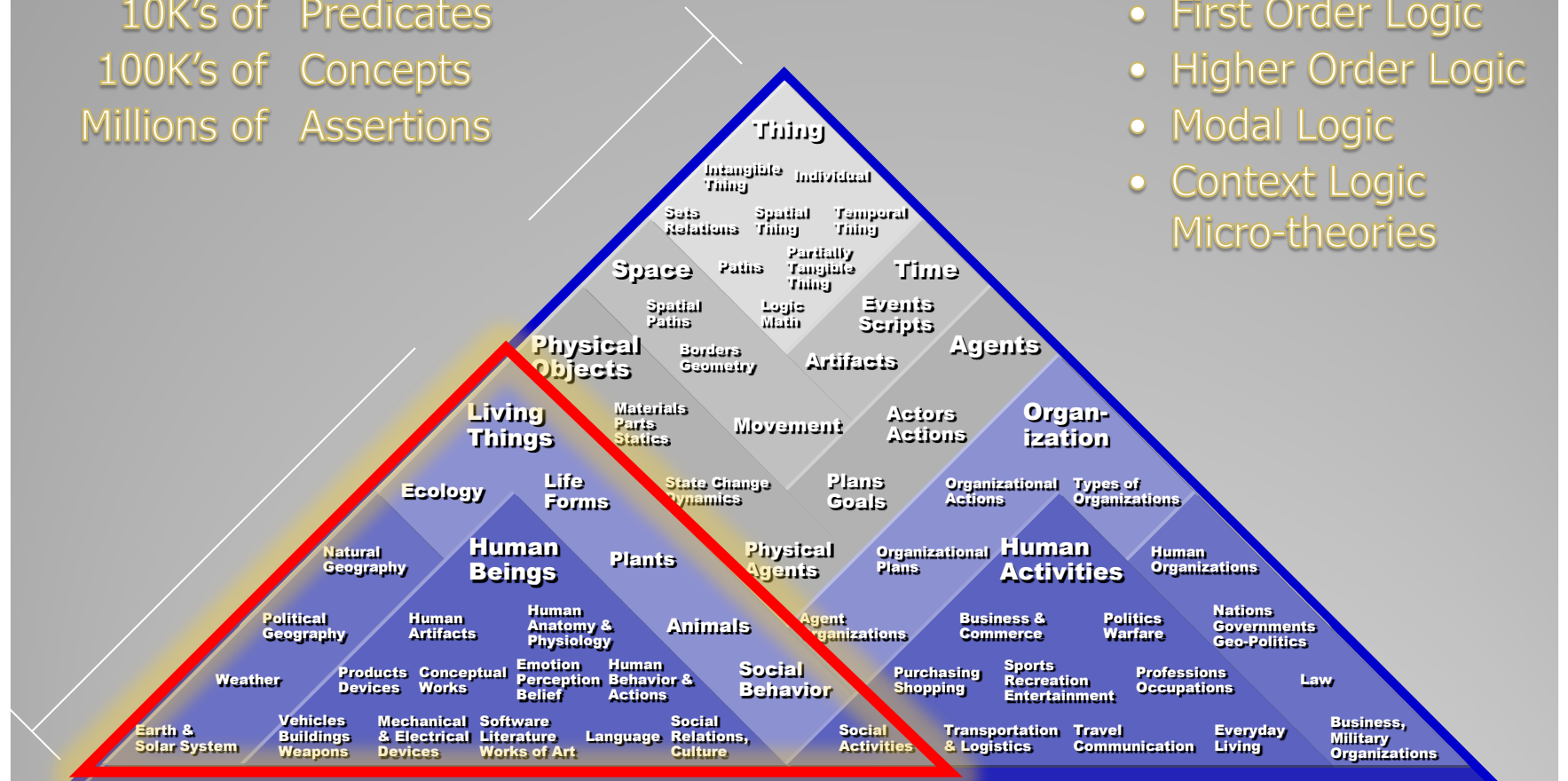
Types of Reasoning, Knowledge

Cyc contains:

10K's of Predicates
100K's of Concepts
Millions of Assertions

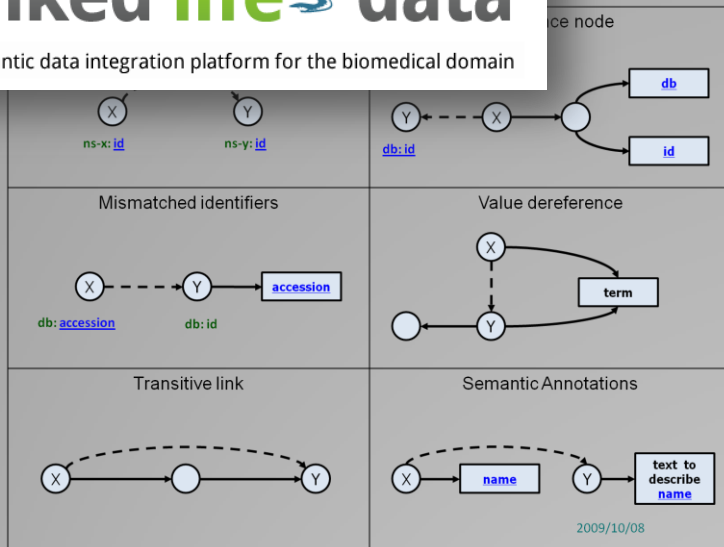
Represented in:

- First Order Logic
- Higher Order Logic
- Modal Logic
- Context Logic
- Micro-theories



General Knowledge about Various Domains

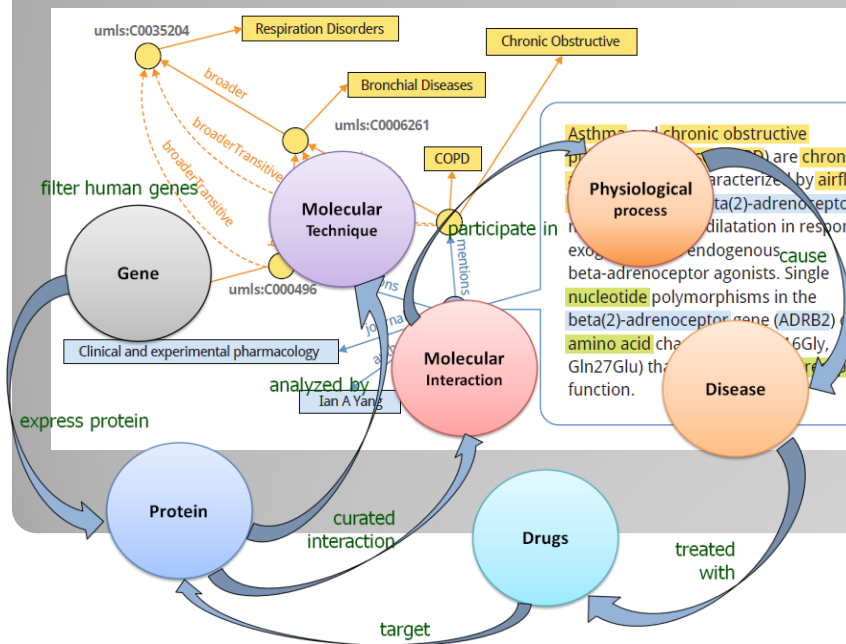
Specific data, facts, and observations



Number of Statements	5,512,293,218
Explicit statements	5,155,779,890
Inferred statements	356,523,328
Size on disk	~320GB
Unique users Jan-Aug 2010	10,226

Data source	Named graph	Load date	Number of statements	Instances type
Disease Ontology	http://linkedlifedata.com/resource/diseaseontology	21.10.10	144,541	diseaseontology:DiseaseOntologyConcept
LinkedCT	http://linkedlifedata.com/resource/linkedct	14.10.10	1,027,378	linkedct:Concept
Reactome	http://linkedlifedata.com/resource/reactome	24.09.10	698,567	biopax-2:entity
HPRD	http://linkedlifedata.com/resource/hprd	24.09.10	1,917,107	biopax-2:entity
DBPedia	http://linkedlifedata.com/resource/dbpedia	20.07.10	496,360,473	skos:Concept
UniProt	http://linkedlifedata.com/resource/uniprot	04.09.10	1,832,491,127	uniprot:Protein
CellMap	http://linkedlifedata.com/resource/cell-map	24.09.10	148,346	biopax-2:entity
NCBI Entrez-Gene	http://linkedlifedata.com/resource/entrezgene	18.10.10	140,024,275	entrezgene:Gene
UMLS SDO	http://linkedlifedata.com/resource/umls	25.11.09	110,568,086	skos:Concept

27 sources



Source dataset	Destination dataset	Linked Data Mapping Rule	Number of connections	Semantic relationship
BioPax Proteins	UniProt	Reference Node	148,941	skos:exactMatch
Drug from DrugBank	Disease from DISEASOME	Causality Relation Extraction	8,201	relationontology:treat
UniProt proteins	UniProt keywords	Causality Relation Extraction	9,004	relationontology:expressIn
LinkedCT criteria	UMLS concepts	Semantic Annotation	844,390	relationontology:hasExclusionCriteria
UniProt GO terms	UMLS concepts (GO)	Mismatched Identifiers	51,024	skos:exactMatch
EntrezGene	UniProt	Causality Relation Extraction	4,923,807	relationontology:encodeProtein
UniProt proteins	GO terms	Causality Relation Extraction	5,053,151	relationontology:hasLocalization
BioPax GO	UMLS concepts (GO)	Reference Node	301,655	skos:relatedMatch
UMLS concepts (NCBI Taxonomy)	UniProt organisms	Value Dereference	412,297	skos:exactMatch
UMLS concepts (MeSH)	PubMed MeSH terms	Value Dereference	25,306	skos:exactMatch
UniProt proteins	GO terms	Causality Relation Extraction	4,000,000	relationontology:participateInBiologicalProcess

29 types of link

First Order

```
(isa AVPR2-Human-GIS GeneTypeBySpeciesAndProductFamily)
(gene-GISTypeCodesForType AVPR2-Human-GIS VasopressinV2Receptor)
```

With Context

```
In Mt : VertebratePhysiologyMt
(relationExistsAll outputsCreated IntramembranousBoneGrowthAndDevelopment FlatBone)
```

Each *vertebrate* flat bone was created by intramembranous bone development.

Rule

```
In Mt: MolecularBiologyMt
(implies
  (isa ?MOLECULE-TYPE TranscriptionFactor)
  (behaviorCapable ?MOLECULE-TYPE
    (ChemicalBindingEventTypeWithTypesFn TranscriptionFactor DNAMolecule)
    objectOfAttachment))
```

Transcription factors can bind with DNA.

Exceptions

```
(implies (and (isa ?MUT GeneticMutationEvent-Cellular)
  (locusOfCellularProcess-Cell ?MUT ?ANCESTOR)
  (isa ?ANCESTOR Cell)
  (subEvents ?REPRO ?MUT))
  (abnormal (TheList ?REPRO ?PROGENY ?ANCESTOR)
    (implies(and
      (isa ?REPRO AsexualReproductionEvent)
      (outputsCreated ?REPRO ?PROGENY)
      (isa ?PROGENY BiologicalLivingObject)
      (doneBy ?REPRO ?ANCESTOR))
      (geneticallyIdentical ?ANCESTOR ?PROGENY))))))
```

Normally, the progeny of asexual reproduction are genetically identical to the parent; however, if the parent is a cell in which a mutation has occurred, this rule doesn't apply.

Syntactic Power

1. Douglas P Kiel, Serkalem Demissie, Josée Dupuis, Kathryn L Lunetta, Joanne M Murabito and David Karasik. *Genome-wide association with bone mass and geometry in the Framingham Heart Study BMC Medical Genetics* 2007, 8(Suppl 1):S14

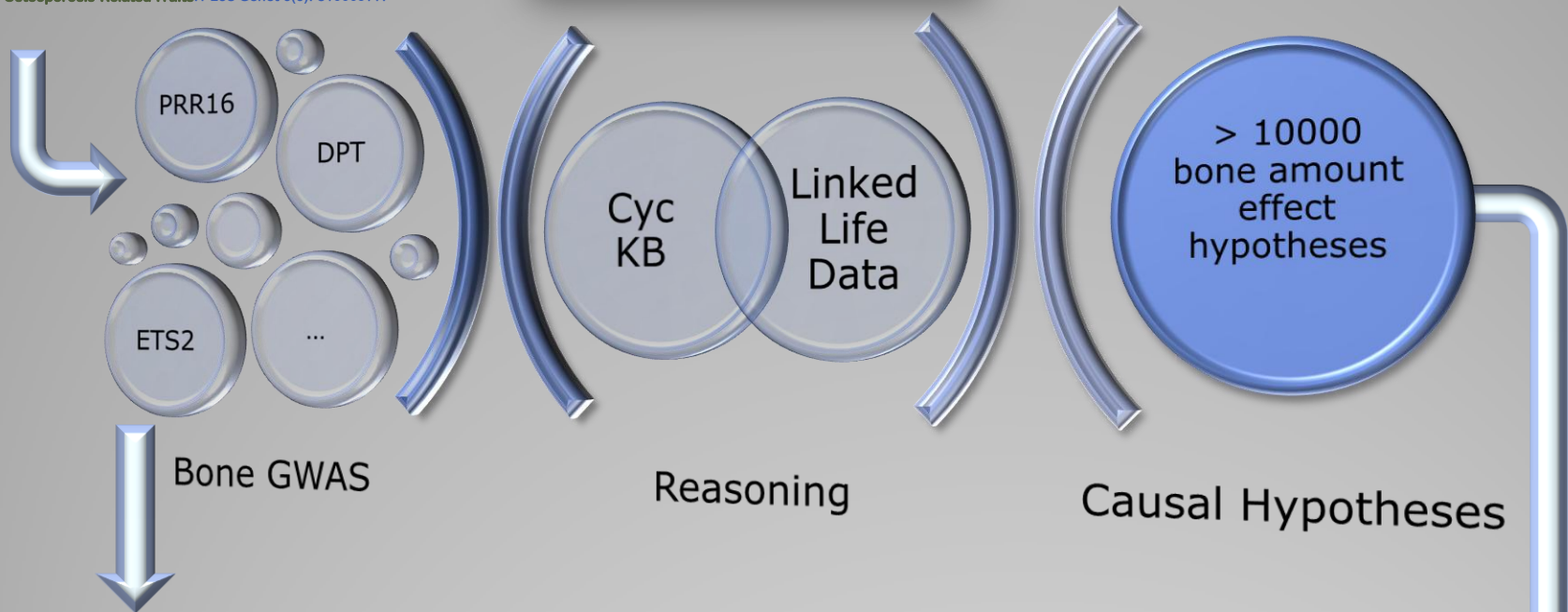
2. Hsu Y-H, Zillikens MC, Wilson SG, Farber CR, Demissie S, et al. (2010) An Integration of **Genome-Wide Association Study** and Gene Expression Profiling to Prioritize the Discovery of Novel Susceptibility Loci for **Osteoporosis-Related Traits**. *PLoS Genet* 6(6): e1000977.

TestQueryFnLLGeneImpactBoneTest2FnETS2-Human-GIS4

What values of ITEM0, ITEM1, ITEM2, and ITEM3 are there such that

- ITEM0 and ETS2 are identical symbols,
- there is some evidence that ITEM0 affects ITEM1,
- there is some evidence that ITEM1 affects ITEM2,
- there is some evidence that ITEM2 affects ITEM3,
- there is some evidence that ITEM3 affects the quantity of bone tissue present,
- and ITEM0 is not ITEM1, ITEM2, or ITEM3?

Logic Query



ITEM0	ITEM1	ITEM2	ITEM3
ETS2	NCOA3	BMP7 BMP6	positive regulation of osteoblast differentiation
interacts with	interacts with	participates in	positive regulation of osteoblast differentiation from MSCs
			positive regulation of bone mineralization



Pilot experiment: GWAS-bone

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	NCOA3	BMP7 BMP6	positive regulation of osteoblast differentiation positive regulation of osteoblast differentiation from MSCs positive regulation of bone mineralization

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	ZMYND11	BMPR1A	positive regulation of osteoblast differentiation positive regulation of osteoblast differentiation from MSCs positive regulation of bone mineralization

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	SRC ZMYND11 TDP2	TRAF6	positive regulation of osteoclast differentiation

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	ZFYVE9	BMP4	positive regulation of osteoblast differentiation positive regulation of osteoblast differentiation from MSCs

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	CREBBP	ACVR1	positive regulation of osteoclast differentiation positive regulation of bone mineralization

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	SRC	TNFSF11	positive regulation of osteoclast differentiation positive regulation of bone resorption

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	NCOR1	SKI	negative regulation of osteoblast differentiation negative regulation of osteoblast differentiation from MSCs

ITEM0	ITEM1	ITEM2	ITEM3
Answer 22	ETS2	BRCA1	positive regulation of osteoblast differentiation

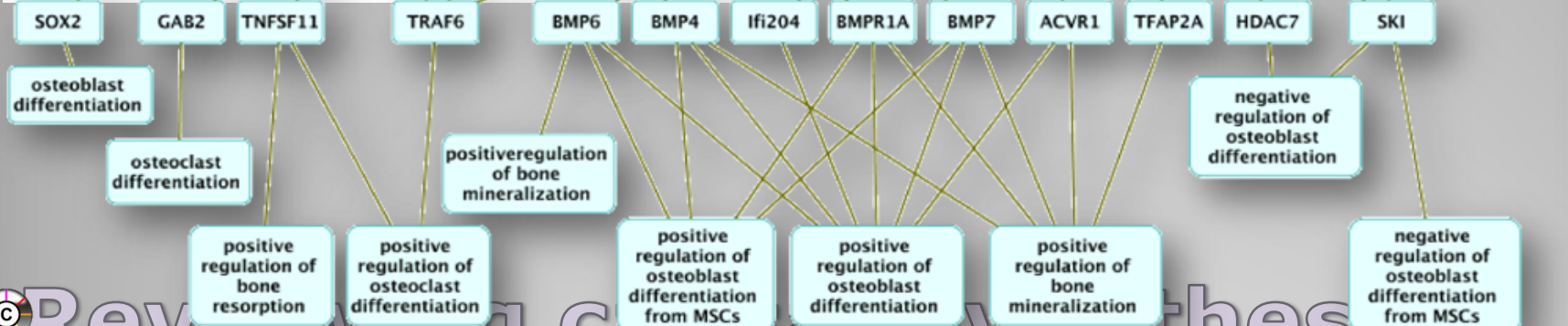
ITEM0	ITEM1	ITEM2	ITEM3
Answer 23	ETS2	EP300	positive regulation of osteoblast differentiation

ITEM0	ITEM1	ITEM2	ITEM3
Answer 24	ETS2	NCOR1	negative regulation of osteoblast differentiation

ITEM0	ITEM1	ITEM2	ITEM3
Answer 25	ETS2	SRC	osteoclast differentiation

ITEM0	ITEM1	ITEM2	ITEM3
Answer 26	ETS2	SOX2	osteoblast differentiation

ITEM0	ITEM1	ITEM2	ITEM3
Answer 27	ETS2	JUN	negative regulation of osteoblast differentiation



Answer:

ITEM0: ETS2

ITEM1: NCOA3

ITEM2: BMP7

ITEM3: positive regulation of osteoblast differentiation

Because:

Detailed Justification:

Linear Justification:

Detailed Justification:

- ▶ There is some evidence that ETS2 affects NCOA3.
- ▼ There is some evidence that BMP7 affects positive regulation of osteoblast differentiation.
 - ▶ If the evidence given for a type of biological process having a type of chemical object as a participant is experimental evidence (as opposed to evidence based on structural similarity or computer matching), and a particular gene codes for that chemical object type, then conclude that instances of the process type typically have the product of that gene as participants.
 - ▶ Inferred from direct assay is a type of experimental evidence.¹
 - ▶ The evidence for Bone morphogenetic protein 7's participation in the positive regulation of osteoblast differentiation was provided by direct assay.
 - ▼ BMP7 codes for Bone morphogenetic protein 7.
 - ▶ If, according to EntrezGene, a gene has a particular term in UniProt as its "uniprotAccession", that gene codes for the type of peptide molecule represented by the UniProt term.

According to EntrezGene, "BMP7" codes for Bone morphogenetic protein 7.
- ▶ There is some evidence that NCOA3 affects BMP7.
- ▶ Inferred from direct assay is a type of experimental evidence.¹
- ▶ There is some evidence that positive regulation of osteoblast differentiation affects the quantity of bone tissue present.

Positive regulation of osteoblast differentiation is more specific than biological processes.

External Sources:

¹Linked Life Ontology

Because:

Detailed Justification:

Linear Justification:

Detailed Justification:

- ▶ There is some evidence that ETS2 affects NCOA3.

```
(couldImpact-BackchainRequired ETS2-Human-GIS  
  (SchemaObjectFn BiqOWLCodeMapping "gene:8202"))
```

- ▶ There is some evidence that BMP7 affects positive regulation of osteoblast differentiation.

```
(couldImpact-BackchainRequired  
  (SchemaObjectFn BiqOWLCodeMapping "gene:655")  
  (PositiveRegulationOfTypeFn OsteoblastDifferentiation))
```

- ▼ There is some evidence that NCOA3 affects BMP7.

```
(couldImpact-BackchainRequired  
  (SchemaObjectFn BiqOWLCodeMapping "gene:8202")  
  (SchemaObjectFn BiqOWLCodeMapping "gene:655"))
```

- ▶ If, according to EntrezGene, gene A has an interaction in which gene B is the interactant, then then molecular products of genes A and B interact.

```
M(implies  
  (and  
    (interactant-EntrezGene ?INTERACTION ?GENE2)  
    (interaction-EntrezGene ?GENE1 ?INTERACTION))  
    (productsOfGene-GISTypesInteract ?GENE2 ?GENE1)) in BiqOWLBriddingMt
```

According to EntrezGene, "NCOA3" is the interactant in <http://linkedlifedata.com/resource/entrezgene/interaction/655-8202>.

```
:SKSI (interactant-EntrezGene  
  (SchemaObjectFn BiqOWLCodeMapping "<http://linkedlifedata.com/resource/entrezgene/interaction/655-8202>")  
  (SchemaObjectFn BiqOWLCodeMapping "gene:8202"))  
in (ContentMtFn BiqOWLIMLinkedLifeTripleStoreNS)
```

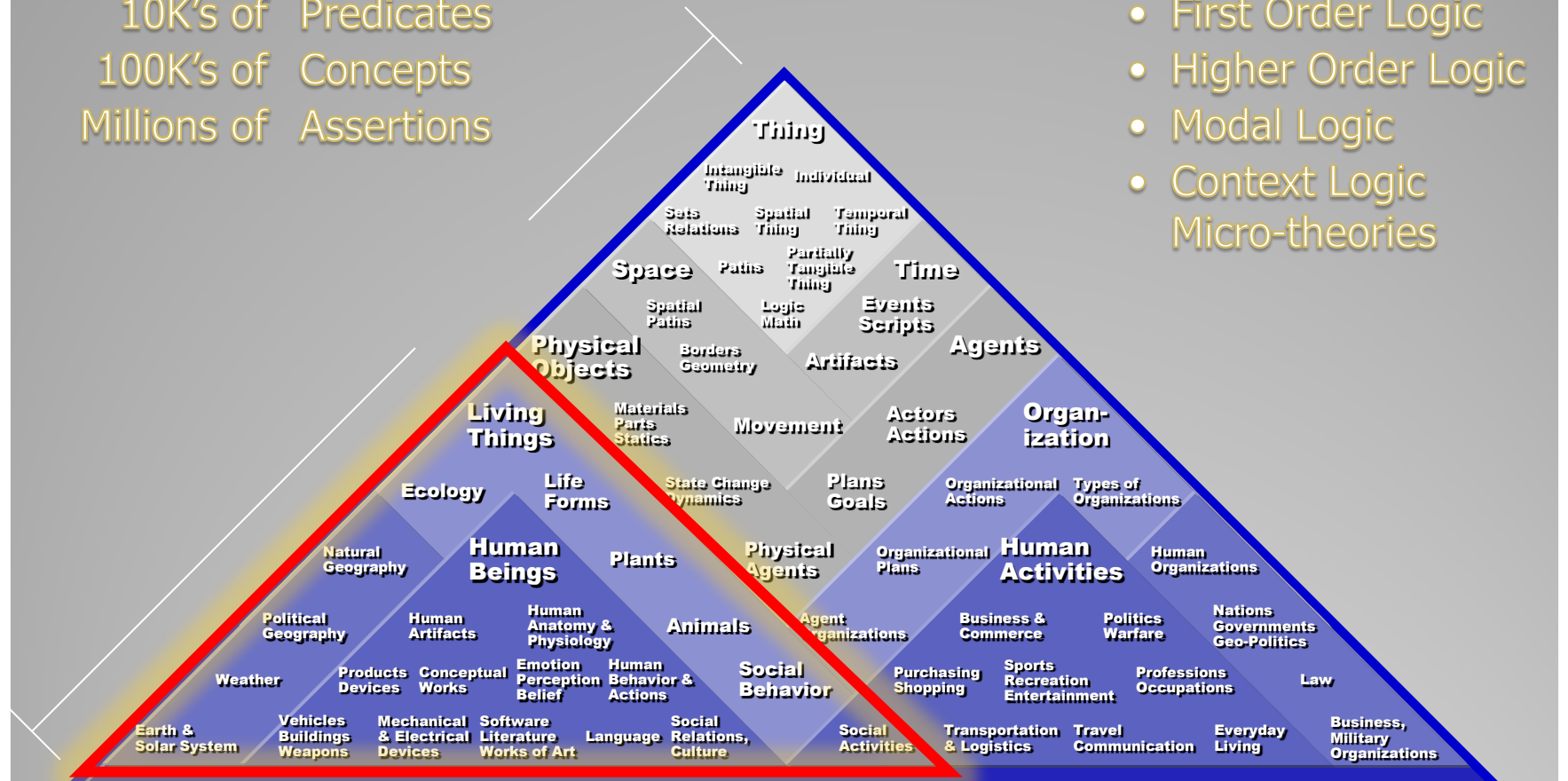
Clearer than logic

Cyc contains:

10K's of Predicates
100K's of Concepts
Millions of Assertions

Represented in:

- First Order Logic
- Higher Order Logic
- Modal Logic
- Context Logic
- Micro-theories



General Knowledge about Various Domains

Specific data, facts, and observations

First Order

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    objectOfAttachment))
```

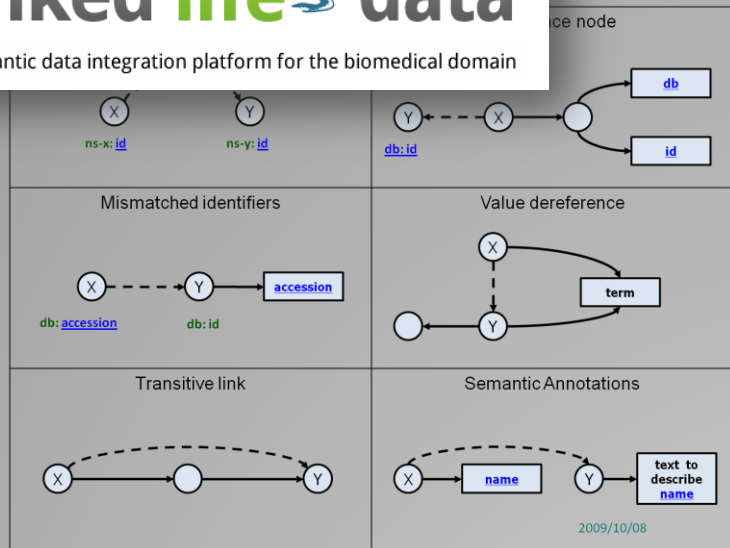
Transcription factors can bind with DNA.

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```
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  (locusOfCellularProcess-Cell ?MUT ?ANCESTOR)
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      (geneticallyIdentical ?ANCESTOR ?PROGENY))))))
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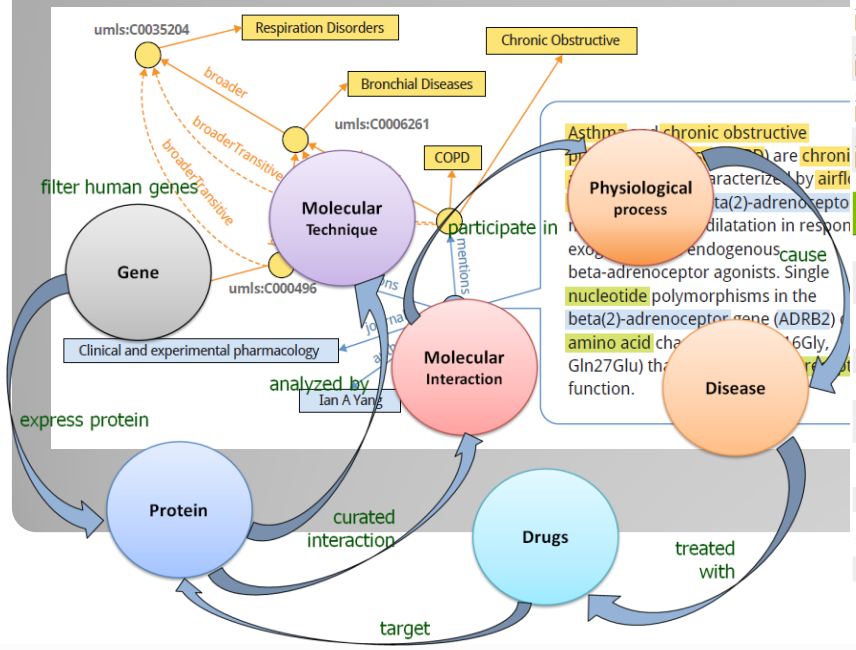
Syntactic Power



Number of Statements	5,512,293,218
Explicit statements	5,155,779,890
Inferred statements	356,523,328
Size on disk	~320GB
Unique users Jan-Aug 2010	10,226

Data source	Named graph	Load date	Number of statements	Instances type
Disease Ontology	http://linkedlifedata.com/resource/diseaseontology	21.10.10	144,541	diseaseontology:DiseaseOntologyConcept
LinkedCT	http://linkedlifedata.com/resource/linkedct	14.10.10	1,027,378	linkedct:Concept
Reactome	http://linkedlifedata.com/resource/reactome	24.09.10	698,567	biopax-2:entity
HPRD	http://linkedlifedata.com/resource/hprd	24.09.10	1,917,107	biopax-2:entity
DBPedia	http://linkedlifedata.com/resource/dbpedia	20.07.10	496,360,473	skos:Concept
UniProt	http://linkedlifedata.com/resource/uniprot	04.09.10	1,832,491,127	uniprot:Protein
CellMap	http://linkedlifedata.com/resource/cell-map	24.09.10	148,346	biopax-2:entity
NCBI Entrez-Gene	http://linkedlifedata.com/resource/entrezgene	18.10.10	140,024,275	entrezgene:Gene
UMLS SDO	http://linkedlifedata.com/resource/umls	25.11.09	110,568,086	skos:Concept

27 sources



Source dataset	Destination dataset	Linked Data Mapping Rule	Number of connections	Semantic relationship
BioPax Proteins	UniProt	Reference Node	148,941	skos:exactMatch
Drug from DrugBank	Disease from DISEASOME	Causality Relation Extraction	8,201	relationontology:treat
UniProt proteins	UniProt keywords	Causality Relation Extraction	9,004	relationontology:expressInHumanMolecule
LinkedCT criteria	UMLS concepts	Semantic Annotation	844,390	relationontology:hasExclusionCriteria
UniProt GO terms	UMLS concepts (GO)	Mismatched Identifiers	51,024	skos:exactMatch
EntrezGene	UniProt	Causality Relation Extraction	4,923,807	relationontology:encodeProtein
UniProt proteins	GO terms	Causality Relation Extraction	5,053,151	relationontology:hasLocalization
BioPax GO	UMLS concepts (GO)	Reference Node	301,655	skos:relatedMatch
UMLS concepts (NCBI Taxonomy)	UniProt organisms	Value Dereference	412,297	skos:exactMatch
UMLS concepts (MeSH)	PubMed MeSH terms	Value Dereference	25,306	skos:exactMatch
UniProt proteins	GO terms	Causality Relation Extraction	4,000,000	relationontology:participateInBiologicalProcess

29 types of link

1. Douglas P Kiel, Serkalem Demissie, Josée Dupuis, Kathryn L Lunetta, Joanne M Murabito and David Karasik. *Genome-wide association with bone mass and geometry in the Framingham Heart Study BMC Medical Genetics* 2007, 8(Suppl 1):S14

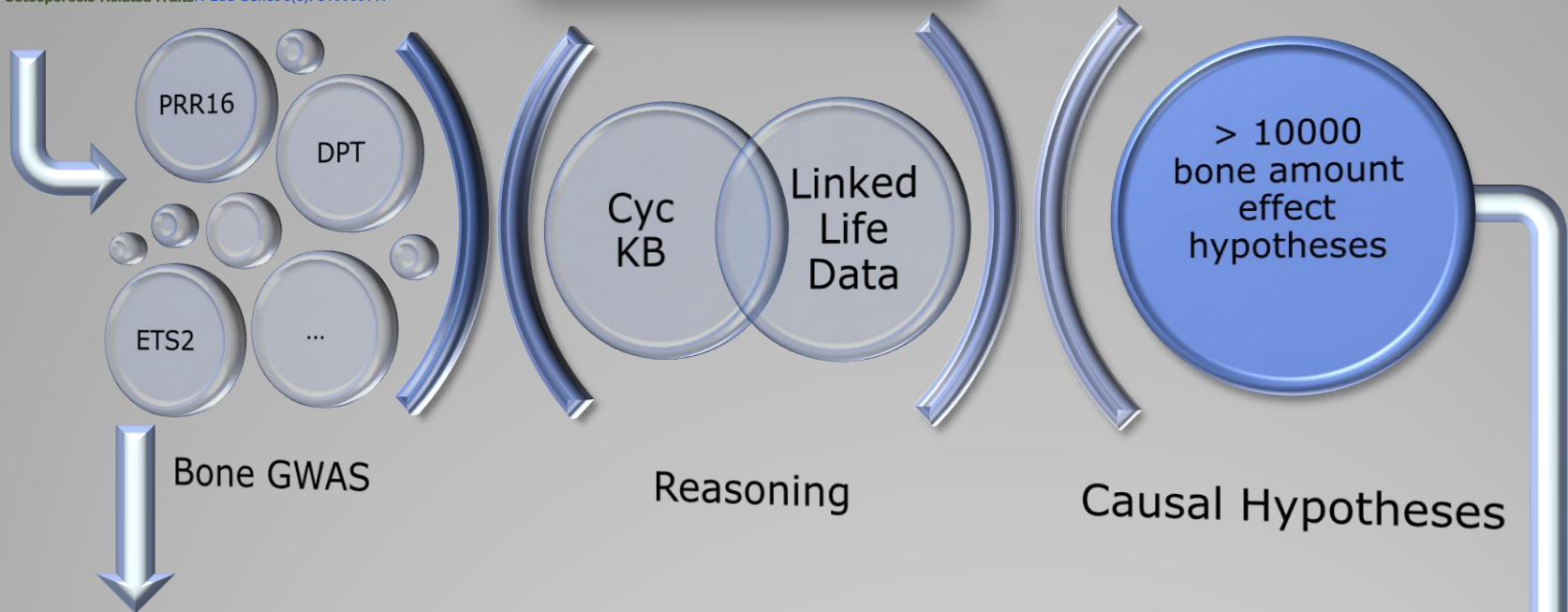
2. Hsu Y-H, Zillikens MC, Wilson SG, Farber CR, Demissie S, et al. (2010) An Integration of **Genome-Wide Association Study** and Gene Expression Profiling to Prioritize the Discovery of Novel Susceptibility Loci for **Osteoporosis-Related Traits**. *PLoS Genet* 6(6): e1000977.

TestQueryFnLLGeneImpactBoneTest2FnETS2-Human-GIS4

What values of ITEM0, ITEM1, ITEM2, and ITEM3 are there such that

- ITEM0 and ETS2 are identical symbols,
- there is some evidence that ITEM0 affects ITEM1,
- there is some evidence that ITEM1 affects ITEM2,
- there is some evidence that ITEM2 affects ITEM3,
- there is some evidence that ITEM3 affects the quantity of bone tissue present,
- and ITEM0 is not ITEM1, ITEM2, or ITEM3?

Logic Query



ITEM0	ITEM1	ITEM2	ITEM3
ETS2	NCOA3	BMP7 BMP6	positive regulation of osteoblast differentiation
interacts with	interacts with	participates in	positive regulation of osteoblast differentiation from MSCs
			positive regulation of bone mineralization



Pilot experiment: GWAS-bone

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	NCOA3	BMP7 BMP6	positive regulation of osteoblast differentiation positive regulation of osteoblast differentiation from MSCs positive regulation of bone mineralization
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	ZMYND11	BMPR1A	positive regulation of osteoblast differentiation positive regulation of osteoblast differentiation from MSCs positive regulation of bone mineralization
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	SRC ZMYND11 TDP2	TRAF6	positive regulation of osteoclast differentiation
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	ZFYVE9	BMP4	positive regulation of osteoblast differentiation positive regulation of osteoblast differentiation from MSCs
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	POUSF1 SRC ZFYVE9 ZMYND11 NCOA3	CREBBP ACVR1	positive regulation of osteoclast differentiation positive regulation of bone mineralization
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	SRC	TNFSF11	positive regulation of osteoclast differentiation positive regulation of bone resorption
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
ETS2	NCOR1	SKI	negative regulation of osteoblast differentiation negative regulation of osteoblast differentiation from MSCs
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
Answer 22	ETS2	BRCA1	positive regulation of osteoblast differentiation
	interacts with	interacts with	participates in

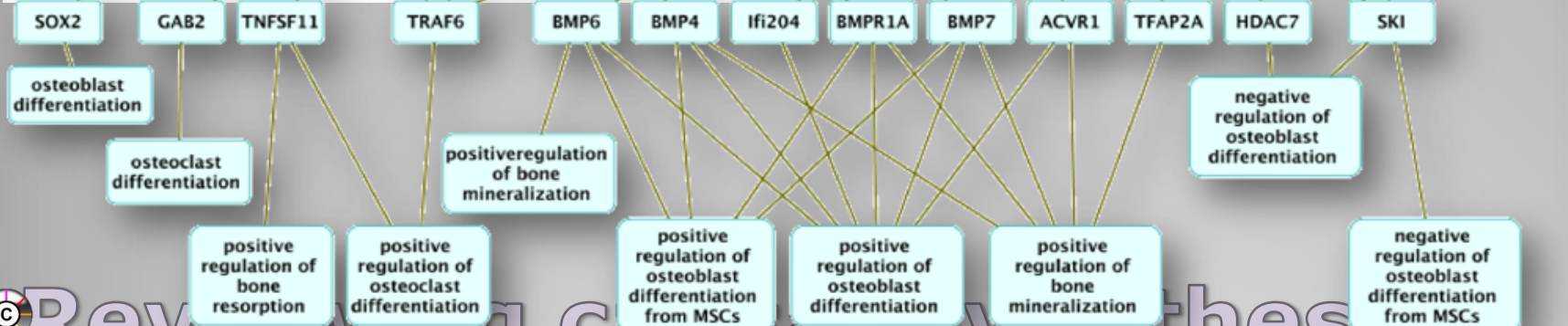
ITEM0	ITEM1	ITEM2	ITEM3
Answer 23	ETS2	EP300	positive regulation of osteoblast differentiation
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
Answer 24	ETS2	NCOR1	negative regulation of osteoblast differentiation
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
Answer 25	ETS2	SRC	osteoclast differentiation
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
Answer 26	ETS2	SOX2	osteoblast differentiation
	interacts with	interacts with	participates in

ITEM0	ITEM1	ITEM2	ITEM3
Answer 27	ETS2	JUN	negative regulation of osteoblast differentiation
	interacts with	interacts with	participates in



Answer:

ITEM0: ETS2

ITEM1: NCOA3

ITEM2: BMP7

ITEM3: positive regulation of osteoblast differentiation

Because:

Detailed Justification:

Linear Justification:

Detailed Justification:

- ▶ There is some evidence that ETS2 affects NCOA3.
- ▼ There is some evidence that BMP7 affects positive regulation of osteoblast differentiation.
 - ▶ If the evidence given for a type of biological process having a type of chemical object as a participant is experimental evidence (as opposed to evidence based on structural similarity or computer matching), and a particular gene codes for that chemical object type, then conclude that instances of the process type typically have the product of that gene as participants.
 - ▶ Inferred from direct assay is a type of experimental evidence.¹
 - ▶ The evidence for Bone morphogenetic protein 7's participation in the positive regulation of osteoblast differentiation was provided by direct assay.
 - ▼ BMP7 codes for Bone morphogenetic protein 7.
 - ▶ If, according to EntrezGene, a gene has a particular term in UniProt as its "uniprotAccession", that gene codes for the type of peptide molecule represented by the UniProt term.

According to EntrezGene, "BMP7" codes for Bone morphogenetic protein 7.
- ▶ There is some evidence that NCOA3 affects BMP7.
- ▶ Inferred from direct assay is a type of experimental evidence.¹
- ▶ There is some evidence that positive regulation of osteoblast differentiation affects the quantity of bone tissue present.

Positive regulation of osteoblast differentiation is more specific than biological processes.

External Sources:

¹Linked Life Ontology

Because:

Detailed Justification:

Linear Justification:

Detailed Justification:

- ▶ There is some evidence that ETS2 affects NCOA3.

```
(couldImpact-BackchainRequired ETS2-Human-GIS  
  (SchemaObjectFn BiqOWLCodeMapping "gene:8202"))
```

- ▶ There is some evidence that BMP7 affects positive regulation of osteoblast differentiation.

```
(couldImpact-BackchainRequired  
  (SchemaObjectFn BiqOWLCodeMapping "gene:655")  
  (PositiveRegulationOfTypeFn OsteoblastDifferentiation))
```

- ▼ There is some evidence that NCOA3 affects BMP7.

```
(couldImpact-BackchainRequired  
  (SchemaObjectFn BiqOWLCodeMapping "gene:8202")  
  (SchemaObjectFn BiqOWLCodeMapping "gene:655"))
```



- ▶ If, according to EntrezGene, gene A has an interaction in which gene B is the interactant, then then molecular products of genes A and B interact.

```
M(implies  
  (and  
    (interactant-EntrezGene ?INTERACTION ?GENE2)  
    (interaction-EntrezGene ?GENE1 ?INTERACTION))  
    (productsOfGene-GISTypesInteract ?GENE2 ?GENE1)) in BiqOWLBriddingMt
```

According to EntrezGene, "NCOA3" is the interactant in <http://linkedlifedata.com/resource/entrezgene/interaction/655-8202>.

```
:SKSI (interactant-EntrezGene  
  (SchemaObjectFn BiqOWLCodeMapping "<http://linkedlifedata.com/resource/entrezgene/interaction/655-8202>")  
  (SchemaObjectFn BiqOWLCodeMapping "gene:8202"))  
in (ContentMtFn BiqOWLIMLinkedLifeTripleStoreNS)
```

Clearer than logic

	ITEM0		ITEM1		ITEM2		ITEM3
Answer 26	ETS2	 interacts with	POU5F1	 interacts with	SOX2	participates in	osteoblast differentiation

Down-rank novelty

Papers mention all three genes together

BMC Genomics



Research article

Open Access

Identification of *Pou5f1*, *Sox2*, and *Nanog* downstream target genes with statistical confidence by applying a novel algorithm to time course microarray and genome-wide chromatin immunoprecipitation data

Alexei A Sharov¹, Shinji Masui², Lioudmila V Sharova¹, Yulan Piao¹, Kazuhiro Aiba¹, Ryo Matoba¹, Li Xin¹, Hitoshi Niwa² and Minoru SH Ko^{*1}

Genes	Suppression of			Genes	Suppression of		
	<i>Pou5f1</i>	<i>Sox2</i>	<i>Nanog</i>		<i>Pou5f1</i>	<i>Sox2</i>	<i>Nanog</i>
<i>Dppa5</i> , <i>Epha1</i> , <i>Epha4</i> , <i>Fbxo15</i> , <i>Ncoart</i> , <i>Socs3</i> , <i>Tcf3</i> , <i>Tofe3</i> , <i>Utr1</i>	↓	No effect	No effect	<i>Gliz</i> , <i>Inhb</i> , <i>Lrrc2</i>	↓	↓	↓
<i>Arid5b</i> , <i>Oas1f</i> , <i>Ptger2</i> , <i>Zic2</i>	No effect	↓	No effect	<i>Dppa3</i> , <i>Gja1</i> , <i>Trh</i>	↓	↓	↓
<i>Brd2</i> , <i>Ccdc5</i> , <i>Fbxo2</i> , <i>Fgf17</i> , <i>Foxp1</i> , <i>Fzd5</i> , <i>Itpr3</i> , <i>Mid1</i> , <i>Rara</i> , <i>Rarg</i> , <i>Sall1</i>	No effect	No effect	↓	<i>Lefty1</i> , <i>Nodal</i>	↓	↓	↓
<i>Dazl</i> , <i>Dnmt3b</i> , <i>Etv1</i> , <i>Foxd3</i> , <i>Gbx2</i> , <i>Id4</i> , <i>Jmjd2c</i> , <i>Klf2</i> , <i>Mkx1</i> , <i>Morc1</i> , <i>Mup4</i> , <i>Mycn</i> , <i>Notch1</i> , <i>Otx2</i> , <i>Pou5f1</i> , <i>Sap30</i> , <i>Set</i> , <i>Suz12</i> , <i>Terr1</i> , <i>Tie1</i> , <i>Upp1</i> , <i>Zic3</i>	↓	↓	No effect	<i>Ccng2</i> , <i>Egln3</i> , <i>Sod1</i>	↓	↓	↓
<i>Myb</i> , <i>Yes1</i> , <i>Zic5</i>	No effect	↓	↓	<i>Cdc42ep3</i> , <i>Six1</i> , <i>Six4</i> , <i>Smad7</i>	↓	↓	No effect
<i>Conb1</i> , <i>Erf</i> , <i>Esrbb</i> , <i>Fgf4</i> , <i>Jak3</i> , <i>Mras</i> , <i>Mts1</i> , <i>Mybl2</i> , <i>Ptch1</i> , <i>Rest</i> , <i>Sfrp1</i> , <i>Sgk</i> , <i>Spred2</i> , <i>Tdgh1</i> , <i>Trp1</i> , <i>Tcfcp2l1</i> , <i>Zfp42</i>	↓	No effect	↓	<i>Arrb1</i> , <i>Cidea</i> , <i>Dmrt1</i> , <i>Eomes</i> , <i>Qk</i> , <i>Smarca2</i> , <i>Tec</i>	↓	↓	No effect
				<i>Cdx2</i> , <i>Fat1</i>	↓	↓	↓
				<i>Dusp4</i> , <i>Hs6st2</i>	↓	↓	↓
				<i>Ets2</i> , <i>Foxh1</i> , <i>Prickle1</i>	↓	↓	↓

Figure 6
Examples of tentative target genes responding differentially to the suppression of *Pou5f1*, *Sox2*, and *Nanog*.



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Examination of transcriptional networks reveals an important role for *TCFAP2C*, *SMARCA4*, and *EOMES* in trophoblast stem cell maintenance

Benjamin L. Kidder¹ and Stephen Palmer

transcription factors (TFs) *POU5F1* (formerly known as *OCT4*), *SOX2*, and *NANOG* (Nichols et al. 1998; Avilion et al. 2003; Chambers et al. 2003), while TS cell self-renewal and multipotency require TFs such as *TCFAP2C*, *CDX2*, *EOMES*, *ESRRB*, *ETS2*, *SOX2*, and *TEAD4* (Chawengsaksophak et al. 1997; Luo et al. 1997; Russ et al. 2000; Auman et al. 2002; Avilion et al. 2003; Wen et al. 2007; Nishioka et al. 2008). Recently, it has been shown that forced expression of *Pou5f1*, *Sox2*, *Klf4*, and *Myc* (formerly known as *c-Myc*) is sufficient to reprogram mouse and human fibroblasts into pluripotent cells (Takahashi et al. 2007a,b; Wernig et al. 2007). It

 Weak knowledge: path ranking

Less likely

Likely correct casual order

More likely

More novel

DCC interacts with CASP3, which interacts with AR, which interacts with IL6ST, which positively regulates osteoblast differentiation

Likely novelty from co-occurence in literature

HTRA1 interacts with BMP4, which interacts with BMPR2, which interacts with BMP2, which has a role in regulating osteoblast differentiation and bone mineralization

Ranking causal hypotheses

```
(triggeringSubEventType TranscriptionFactorActivatedTranscription
  (ChemicalBindingEventWithTypesFn Gene-DNARegion TranscriptionFactor))
```

Binding to a DNA region triggers activation of transcription by a transcription factor molecule.

```
(implies (triggeringSubEventTypes ?EVT-TYPE ?SUB-TYPE)
  (and (sufficientTriggeringSubEventTypes ?EVT-TYPE ?SUB-TYPE)
    (firstSubEventTypes ?EVT-TYPE ?SUB-TYPE)))
```

Triggering sub-events are the first sub-events of the event as a whole, and are sufficient to begin it.

```
(firstSubEventTypes TranscriptionFactorActivatedTranscription
  (ChemicalBindingEventWithTypesFn Gene-DNARegion TranscriptionFactor))
```

Activation of transcription by a factor molecule starts with the binding of that transcription factor to the some region of DNA.



Transcription factors activate transcription. Coactivators can bind with the transcription factors to upregulate the transcription, which increases the expression of the gene.

Richly represented knowledge

```
(implies (coactivatesTranscriptionOfTypeInitiatedByType
          ?COAC-TYPE ?GIS-TYPE ?TF-TYPE)
  (causes-SitTypeSitType
    (ChemicalBindingEventTypeWithTypesFn
      ?COAC-TYPE ?TF-TYPE)
    (UpregulationOfTypeFn
      (ChemicalBindingEventWithTypesFn
        (DNARegionForGeneFn ?GIS-TYPE) ?TF-TYPE))))
```

When a molecule is known to act as a coactivator with a certain transcription factor in the transcription of a gene, binding of the coactivator to the transcription factor causes an upregulation of the transcription factor's binding to the DNA region for that gene.

```
(implies
  (triggeringSubEventType ?EVENT-TYPE ?SUB-TYPE)
  (causes-SitTypeSitType
    (UpregulationOfTypeFn?TRIGGER-UPREG-TYPE)
    (UpregulationOfTypeFn ?UPREG-TYPE)))
```

Upregulation of a triggering sub-event causes upregulation of the overall event type.





Transcription factors activate transcription. Coactivators can bind with the transcription factors to upregulate the transcription, which increases the expression of the gene.

Richly represented knowledge
This can be used to explain an "interaction" between a gene and a coactivator.

	ITEM0		ITEM1		ITEM2		ITEM3
Answer 22	ETS2	 interacts with	BRCA1	 interacts with	Irf204	participates in	positive regulation of osteoblast differentiation
Answer 23	ETS2	 interacts with	EP300	 interacts with	TFAP2A	participates in	positive regulation of bone mineralization
Answer 24	ETS2	 interacts with	NCOR1	 interacts with	HDAC7	participates in	negative regulation of osteoblast differentiation
Answer 25	ETS2	 interacts with	SRC	 interacts with	GAB2	participates in	osteoclast differentiation
Answer 26	ETS2	 interacts with	POU5F1	 interacts with	SOX2	participates in	osteoblast differentiation
Answer 27	ETS2	 interacts with	JUN	 interacts with	SKI	participates in	negative regulation of osteoblast differentiation

Applying richer knowledge

	ITEM0		ITEM1		ITEM2		ITEM3
Answer 23	ETS2	 interacts with	EP300	 interacts with	TFAP2A	participates in	positive regulation of bone mineralization

Regulation of transcription of the human presenilin-1 gene by ets transcription factors and the p53 protooncogene.

Pastorcic M, Das HK.


Department of Pharmacology and Neuroscience and Department of Molecular Biology and Immunology, University of North Texas Health Science Center, Fort Worth, Texas 76107, USA. mpastorc@hsc.unt.edu

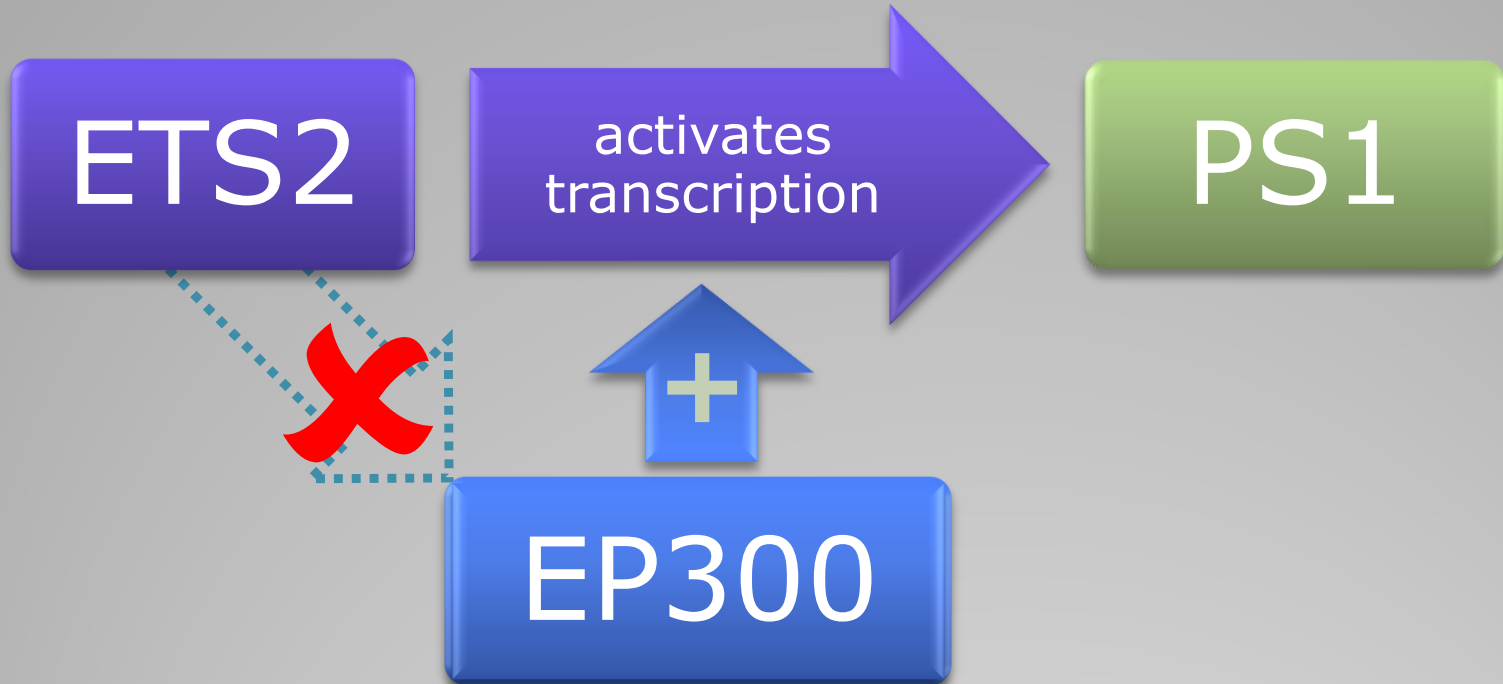
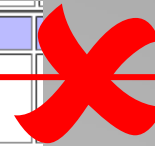
Abstract

The expression of the human presenilin-1 cellular gene is suppressed by the p53 protooncogene. The rapid kinetic of the down-regulation has suggested that it may result from a primary mechanism. We show here that p53 also suppresses the transcription of a presenilin-1 promoter-chloramphenicol acetyltransferase reporter synthetic gene in transient infection assays in neuroblastoma (SK-N-SH) and hepatoma (HepG2) cell lines. Only a minimum promoter including sequences from -35 to +6 from the transcription initiation is sufficient to confer down-regulation. We have previously defined a crucial DNA element controlling 90% of the expression of the gene within the same short area, and the identification of the transcription factors involved should also provide insights into the regulation of PS1 by p53. This region contains an Ets transcription factor binding motif, and a 2-base pair alteration within the core sequence (GGAA to TTAA) of the Ets consensus also reduced transcription by more than 90%. We now show that Ets1 and Ets2 indeed transactivate a PS1 promoter-chloramphenicol acetyltransferase reporter including the (-35 to +6) fragment. Furthermore, in vitro translated Ets2 binds specifically to the -10 Ets motif in electrophoretic mobility shift assays. Therefore, Ets1/2 factors bind specifically to the -10 Ets element and activate PS1 transcription. We also show that the coactivator p300 enhances the activation by Ets1 and Ets2 as well as the repression by p53. p300 is known to interact with p53 as well as with Ets1 and Ets2. We show that p53 does not bind directly to the PS1 promoter. Hence the repression of PS1 transcription by p53 is likely to be mediated through protein-protein interactions.

PMID: 10942770 [PubMed - indexed for MEDLINE] [Free full text](#)

Is the pathway justified

ITEM0		ITEM1
ETS2	 interacts with	EP300



More detailed model

Collaborative Knowledge Creation



human ETS2 gene - Google Chrome



cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rcarEA6RpSLSNvdjTkBKRvg&cycHost=xen2g&cy

◀ **human ETS2 gene** ▶ (aka ETS2, the human ETS2 gene)

Basic Info

Related

Advanced Info (5★)

ETS2 is a type of:

👍🗨️ human gene (nucleic acid sequence)

What type of thing is this?

Additional Names

👍🗨️ ETS2

👍🗨️ the human ETS2 gene

Click to add another name

Focus on

Go

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Collaborative Knowledge Creation

type of protein - Google Chrome

cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rcarEA6RpSLSNvdjTkBKRvg&cycHost=xen2g&cyc

◀ **type of protein** ▶ (aka variety of protein molecule, kind of protein molecule, type of protein molecule, ...)

Basic Info **Related** Advanced Info (1★)

protein molecule type by chemical compound type
ProteinMoleculeTypeByChemicalCompoundType

type of molecule differentiated by chemical formula
MoleculeTypeByChemicalSpecies

type of protein
ProteinMoleculeTypeByChemicalSpecies

+ + type of bacterial protein
BacterialProteinType

Beta-catenin
Beta-catenin

Protein C-ets-2
ProteinC-ets-2

A factor receptor
AFactorReceptor

alpha factor receptor
AlphaFactorReceptor

... DNA synthetase

Collaborative Knowledge Creation

type of protein - Google Chrome

cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rcarEA6RpSLSNvdjTkBKRvvg&cycHost=xen2g&cy

◀ **type of protein** ▶ (aka variety of protein molecule, kind of protein molecule, type of protein molecule, ...)

Basic Info Related **Advanced Info (1★)**

```
graph TD; A[protein molecule  
ProteinMolecule] --- B[Protein C-ets-2  
ProteinC-ets-2]; B --- C(+); B --- D(+);
```

protein molecule
ProteinMolecule

Protein C-ets-2
ProteinC-ets-2

+ +

Collaborative Knowledge Creation


Protein C-ets-2 - Google Chrome

cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rcarEA6RpSLSNvdjTkBKRvg&cycHost=xen2g&cy

◀ Protein C-ets-2 ▶



Basic Info Related Advanced Info (7★)

Protein C-ets-2 is a type of:

 [protein molecule \(peptide\)](#)
(genls ProteinC-ets-2 ProteinMolecule)

What type of thing is this?

Additional Names

  [Protein C-ets-2](#)
(and (ist EnglishMt (nameString ProteinC-ets-2 'Protein C-ets-2')))

Click to add another name

Focus on

Collaborative Knowledge Creation

◀ Protein C-ets-2 ▶

Basic Info

Related

Advanced Info (8★)

Protein C-ets-2 stimulates the biosynthesis of

protein



Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.



Biological tissue of type *tissue* typically synthesizes the protein molecule Protein C-ets-2.



Protein C-ets-2 initiates *nucleotide sequence of a gene* transcription.



cell cells typically synthesize Protein C-ets-2.



The gene **ETS2** codes for Protein C-ets-2.



The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.



Focus on

Go

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Collaborative Knowledge Creation

◀ Protein C-ets-2 ▶

Basic Info

Related

Advanced Info (8★)

Protein C-ets-2 stimulates the biosynthesis of

protein

Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.

Biological tissue of type *tissue* typically synthesizes the protein molecule Protein C-ets-2.

Protein C-ets-2 initiates *nucleotide sequence of a gene* transcription.

cell cells typically synthesize Protein C-ets-2.



The gene codes for Protein C-ets-2.

The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.

Focus on

Go


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Collaborative Knowledge Creation

◀ Protein C-ets-2 ▶

Basic Info

Related

Advanced Info (8 )

Protein C-ets-2 stimulates the biosynthesis of

protein



Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.



Biological tissue of type *tissue* typically synthesizes the protein molecule Protein C-ets-2.



Protein C-ets-2 initiates *PS1* transcription.  



cell cells typically synthesize Protein C-ets-2.



The gene *ETS2* codes for Protein C-ets-2.



The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.



Focus on

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Protein C-ets-2 - Google Chrome

cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rGcXRt2XERnirmFIMekTTFg&cycHost=xen2g&c

Protein C-ets-2

Basic Info Related **Advanced Info (8★)**

Protein C-ets-2 stimulates the biosynthesis of *protein*.

Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.

Biological tissue *cell* synthesizes the *protein*.

Protein C-ets-2 *cell* in C-ets-2.

The gene *ETS2* codes for Protein C-ets-2.

The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.

Working - +

Focus on Go Show Cycl

Not Understood

Unable to understand "PS1".

Would you like to define it?

Yes No

Collaborative Knowledge Creation

Protein C-ets-2 - Google Chrome

cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rGcXRt2XERnirmFIMekTTFg&cycHost=xen2g&c

◀ **Protein C-ets-2** ▶

Basic Info Related **Advanced Info (8★)**

Protein C-ets-2 stimulates the biosynthesis of *protein*.

Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.

Biological tissue *protein* synthesizes the *protein*.

Protein C-ets-2 *cell* *protein* in C-ets-2.

Working - +

👍👎 The gene **ETS2** codes for Protein C-ets-2.

The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.

Focus on Go Show Cycl

Not Understood

Which of the following describe 'PS1'?

nucleotide sequence of a gene

Create Cancel

Collaborative Knowledge Creation

Protein C-ets-2 - Google Chrome

cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rGcXRt2XERnirmFIMekTTFg&cycHost=xen2g&c

◀ Protein C-ets-2 ▶

Basic Info Related **Advanced Info (10★)**

Protein C-ets-2 stimulates the biosynthesis of *protein*.

Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.

Biological tissue of type *tissue* typically synthesizes the protein molecule Protein C-ets-2.

👍👎 Protein C-ets-2 initiates **PS1** transcription.

cell cells typically synthesize Protein C-ets-2.

👍👎 The gene **ETS2** codes for Protein C-ets-2.

The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.

👍👎 Protein C-ets-2 is coactivator that increases PS1 transcription by Protein C-ets-2.

Focus on

Collaborative Knowledge Creation

◀ Protein C-ets-2 ▶

Protein C-ets-2 stimulates the biosynthesis of

protein

Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.

Biological tissue of type *tissue* typically synthesizes the protein molecule Protein C-ets-2.



Protein C-ets-2 initiates transcription.

cell cells typically synthesize Protein C-ets-2.



The gene codes for Protein C-ets-2.

The presence of Protein C-ets-2 in *living thing*

causally contributes to *organic process*.

is coactivator that increases PS1 transcription by Protein C-ets-2.



Protein C-ets-2 initiates Protein C-ets-2 transcription.

Focus on

Go

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Protein C-ets-2 - Google Chrome

cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rGcXRt2XERnirmFIMekTTFg&cycHost=xen2g&c

◀ Protein C-ets-2 ▶

Protein C-ets-2 stimulates the biosynthesis of *protein*.

Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.

Biological tissue *synthesizes the*

Protein C-ets-2 *cell* in C-ets-2.

The gene *ETS*

The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.

EP300 is coactivator that increases PS1 transcription by Protein C-ets-2. **Working**

Protein C-ets-2 initiates Protein C-ets-2 transcription.

Not Understood

Unable to understand "EP300".

Would you like to define it?

Focus on

Collaborative Knowledge Creation

◀ Protein C-ets-2 ▶

Basic Info | Related

- Protein C-ets-2 stimulates the biosynthesis of *protein*.
- Protein C-ets-2 stimulates *cell* to increase their expression of *protein*.
- Biological tissue of type *tissue* typically synthesizes the protein molecule Protein C-ets-2.
- 👍👎 Protein C-ets-2 initiates **PS1** transcription.
- cell* cells typically synthesize Protein C-ets-2.
- 👍👎 The gene **ETS2** codes for Protein C-ets-2.
- The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*.
- 👍👎 **EP300** is coactivator that increases PS1 transcription by Protein C-ets-2.

Focus on

Collaborative Knowledge Creation

The image shows a screenshot of a web browser window displaying a biological pathway from the Gene Ontology (GO) database. The browser's address bar shows the URL: `cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rGcXRt2XERnirmFIMekTTFg&cycHost=xen2g&c`. The page title is "Protein C-ets-2".

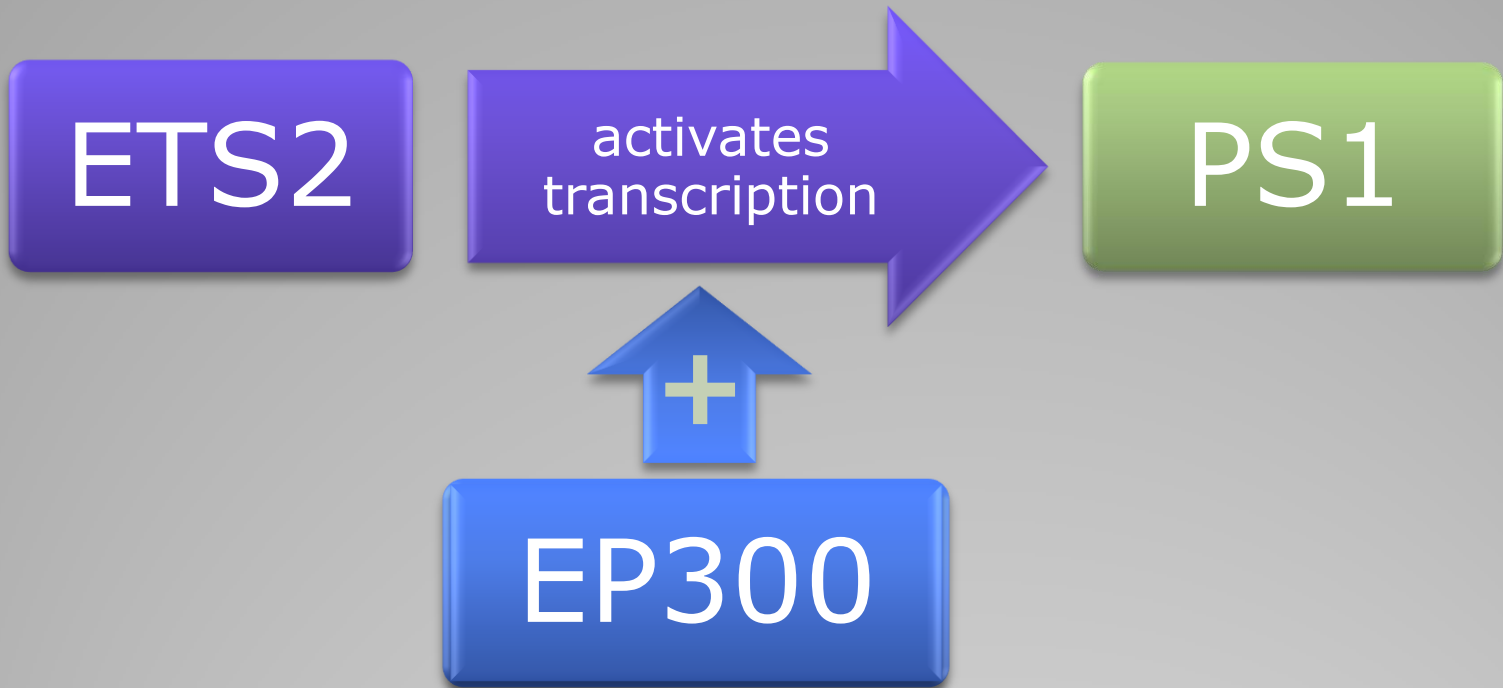
Overlaid on the screenshot are several graphical annotations:




- A purple box labeled "ETS2" is connected by a blue line to a large purple arrow pointing right, labeled "activates transcription".
- The arrow points to a green box labeled "PS1".
- A blue box labeled "EP300" is positioned below the arrow, with a blue arrow pointing up towards it.
- A yellow rectangular box highlights a text entry in the lower part of the page: "EP300 is coactivator that increases PS1 transcription by Protein C-ets-2".

The background text from the browser includes:

- "Protein C-ets-2 stimulates *cell* to increase their expression of *protein*"
- "Biological tissue of type *tissue* typically synthesizes the protein molecule *Protein C-ets-2*."
- "Protein C-ets-2 initiates *cell* to synthesize Protein C-ets-2."
- "The gene *ETS2*"
- "The presence of Protein C-ets-2 in *living thing* causally contributes to *organic process*"
- "*EP300* is coactivator that increases PS1 transcription by Protein C-ets-2"

Collaborative Knowledge Creation



  EP300 ▼ is coactivator that increases PS1 transcription by Protein C-ets-
2. 

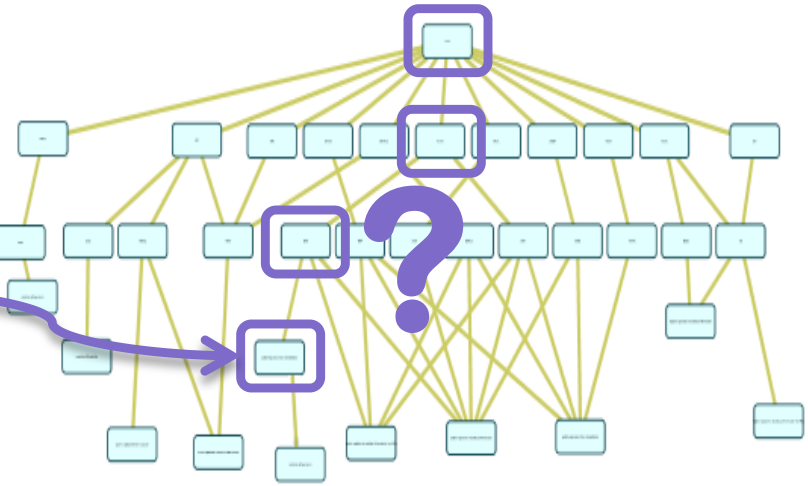
Collaborative Knowledge Creation

Framingham SHARe

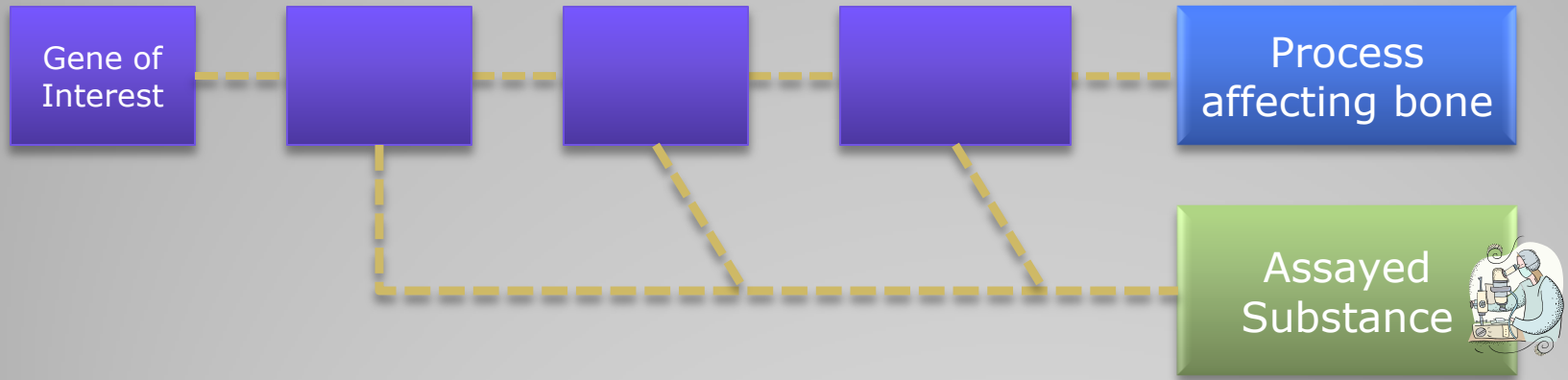
-
- CD40 ligand from plasma, ng/ml
- TNF alpha, pg/ml
- Osteoprotegerin from plasma, pmol/L
- Vitamin D, ng/l
- Cystatin C, mg/L
- P-selectin from plasma, ng/ml
- hundreds more



CD40L
TNF
TNFRSF11B
CYP27B1
CST3
SELP



What data is available to test hypothesis plausibility?



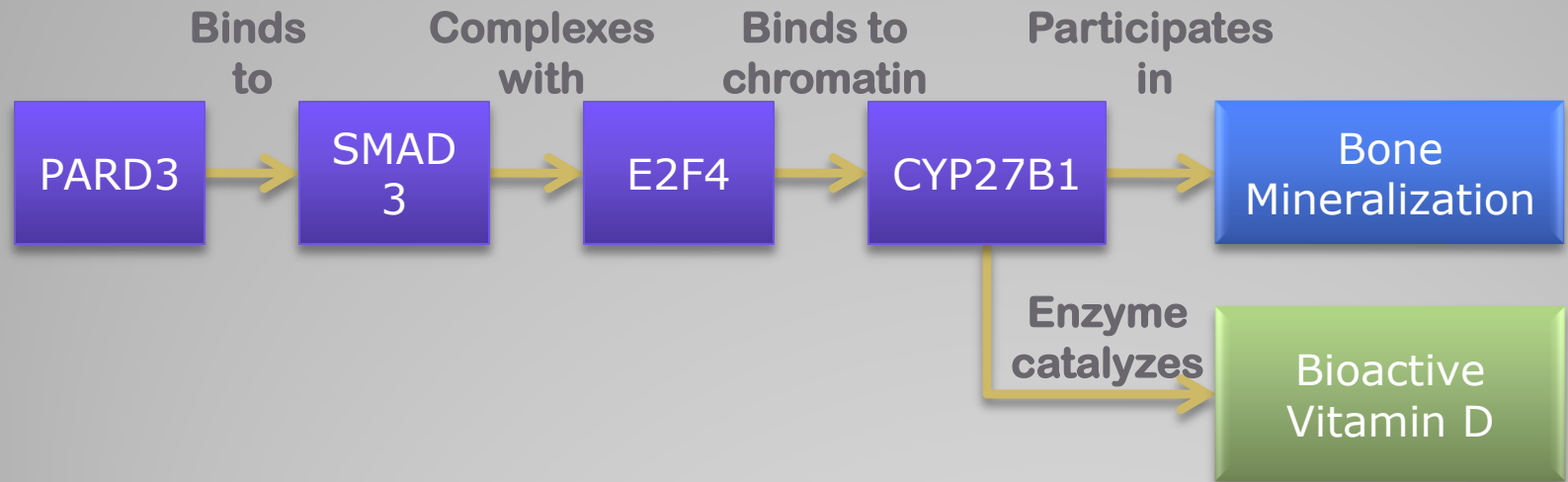
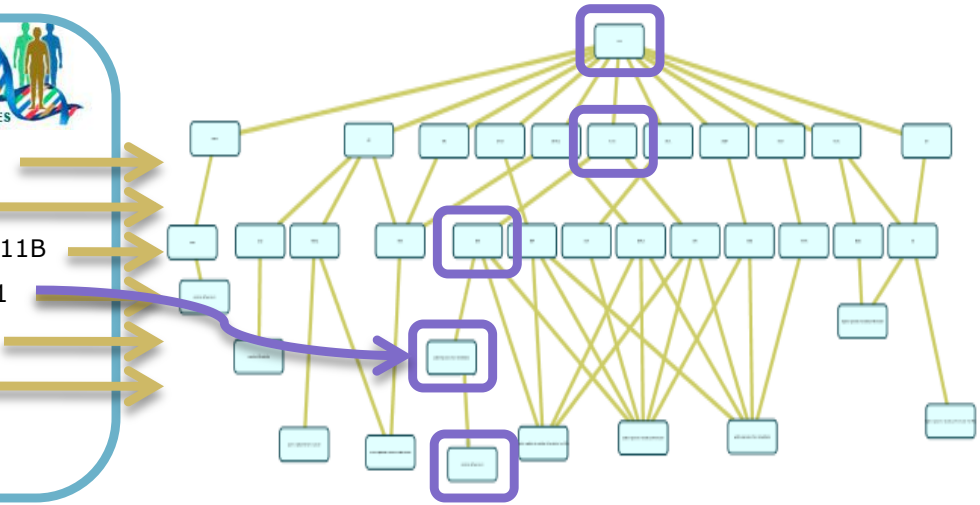
Patient Data: Metabolic Products

Framingham SHARE

-
- CD40 ligand from plasma, ng/ml
- TNF alpha, pg/ml
- Osteoprotegerin from plasma, pmol/L
- Vitamin D, ng/l
- Cystatin C, mg/L
- P-selectin from plasma, ng/ml
- hundreds more



CD40L
TNF
TNFRSF11B
CYP27B1
CST3
SELP



Patient Data: Metabolic Products

UniProtKB UniProtKB Downloads · Contact · Documentation/Help

Search Blast * Align Retrieve ID Mapping *

Search in Protein Knowledgebase (UniProtKB) Query Search Clear Advanced Search »

P12644 (BMP4_HUMAN) ★ Reviewed, UniProtKB/Swiss-Prot
 Last modified May 31, 2011. Version 134. History...

Contribute
 Send feedback
 Read comments (0) or add your own

Clusters with 100%, 90%, 50% identity | Documents (5) | Third-party data text xml rdf/xml gff fasta

Names · Attributes · General annotation · Ontologies · Interactions · Sequence annotation · Sequences · References · Web links · Cross-refs · Entry info · Documents · Customize order

Names and origin

Protein names	Recommended name: Bone morphogenetic protein 4 Short name=BMP-4
---------------	--

General annotation (Comments)

Function	Induces cartilage and bone formation. Also act in mesoderm induction, tooth development, limb formation and fracture repair. Acts in concert with PTHLH/PTHRP to stimulate ductal outgrowth during embryonic mammary development and to inhibit hair follicle induction (By similarity).
----------	--

Richer Data, Richer Knowledge

Induces cartilage and bone formation. Also act in mesoderm induction, tooth development, limb formation and fracture repair. Acts in concert with PTHLH/PTHRP to stimulate ductal outgrowth during embryonic mammary development and to inhibit hair follicle induction [\(By similarity\)](#).

Parsing Template Problems (0) Trace Output

S:

Richer Data, Richer Knowledge

Induces cartilage and bone formation. Also act in mesoderm induction, tooth development, limb formation and fracture repair. Acts in concert with PTHLH/PTHRP to stimulate ductal outgrowth during embryonic mammary development and to inhibit hair follicle induction (By similarity).

Parsing Template Problems (0) Trace Output

S: Bone morphogenetic protein 4 induces cartilage and bone formation.

Parsed: Bone morphogenetic protein 4 induces cartilage and bone formation.

Partial Parse:

E: The presence of Bone morphogenetic protein 4 in mammal causally contributes to cartilage development and the presence of Bone morphogenetic protein 4 in mammal causally contributes to bone formation.

C: (and
(substanceInBLOContributesToBioProcess-TypeLevel
(SchemaObjectFn BigOWLCodeMapping "uniprot-protein:P12644") Mammal
(TissueFormationFn Cartilage))
(substanceInBLOContributesToBioProcess-TypeLevel
(SchemaObjectFn BigOWLCodeMapping "uniprot-protein:P12644") Mammal BoneFormation))

Section:

Parsed by EBMT using construction:
NL: ["\$ProteinMolecule#0 induces \$AnimalTissue#1 and \$BiologicalProductionEvent#2"]
Logic: (#\$and (#\$substanceInBLOContributesToBioProcess-TypeLevel \$ProteinMolecule#0 #SMammal (#\$TissueFormationFn \$AnimalTissue#1)
(#\$substanceInBLOContributesToBioProcess-TypeLevel \$ProteinMolecule#0 #SMammal \$BiologicalProductionEvent#2))
Var: ?DEFAULT-VAR
Type: CycL.Sentence-Assertible
Mt: #SCurrentWorldDataCollectorMt-NonHomocentric
InP: CycAPI Inference.Params needs toString method

Richer Data, Richer Knowledge

- Technology Steps
 - Use all current structured interaction, chemical, pathway *etc* knowledge
 - Model and elicit, and read increasing variety of high precision (causal, explanatory) knowledge
 - Improve display and explanation of causal hypotheses
 - Improve hypothesis ranking techniques, learn from user responses to hypotheses
- Data steps
 - Apply to more GWAS studies
 - Comprehensive knowledge of possible and performed assays, starting with Framingham Heart Study
- Community Steps
 - Insert human-computer collaborative knowledge elicitation and curation into existing workflows
 - first into KB workflows, then into research and publication



Scaling out and scaling up

Palm, Inc.

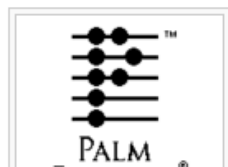
From Wikipedia, the free encyclopedia

Palm, Inc. is a personal digital assistant manufacturer headquartered in Sunnyvale, California. The company produces products such as the Zire, Tungsten, and LifeDrive. Previous product lines include the Treo and Palm VII. While their older products run the Treo operating system, Palm webOS, Palm OS Garnet.^[2]

Contents [hide]

- 1 History
- 2 List of PDA models
 - 2.1 Current models
 - 2.2 Upcoming models
 - 2.3 Discontinued models
- 3 Environmental Record
- 4 See also
- 5 References
- 6 External links

History



Palm Co
Hawkins,
and Ed C

invention of the Palm Pilot. The company was started

Palm, Inc. (aka Palm)

About Basic Info Documentation **Advanced Info** Affiliations

- Ed Colligan is Palm's CEO.
- person* is the COO of Palm.
- person* is the CFO of Palm.
- Jeff Hawkins founded Palm.
- Donna Dubinsky founded Palm.
- is a leader of Palm.
- Palm is headed by *person*.
- business* parent company is Palm.
- Palm founded *organization*.
- Palm is a major company in *geographical region*.
- organization* is a suborganization of Palm.
- Palm is legally incorporated in *political entity*.
- The main business activity of Palm occurs at *geographical region*.
- <http://palm.com> is the URL for Palm's homepage.

Employees 1,050 (2008)^[1]

(generateFormulasForElements-TermIsa **PubliclyHeldCorporation**
(TheSet **stockTickerSymbol**))

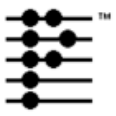
(generateFormulasForElements-TermIsa **CommercialOrganization**
(TheSet **importantCompany**
subOrganizations
mainBusinessActivityOfOrgOccursAt
foundingAgent
incorporatedIn))

The screenshot shows a web application interface with a sidebar on the left and a main content area. The sidebar contains a 'Contents' section with links to 'History', 'List of PDA models', 'Environmental Record', 'See also', 'References', and 'External links'. Below this is a 'History' section with a logo for 'PALM' and a list of items including 'Palm Co', 'Hawkins', and 'Ed C'. The main content area displays a list of terms with checkboxes and associated concepts. A large blue arrow points from the text above to the term 'The main business activity of Palm occurs at geographical region'. Other terms include 'Palm is headed by person', 'business', 'Palm founded organization', 'Palm is a major company in geographical region', 'organization', 'Palm is legally incorporated in political entity', and 'http://palm.com is the URL for Palm's homepage'. The bottom of the page shows a link to 'Employees' and a value of '1,050 (2008)'.

Contents [hide] <

- 1 History <<
- 2 List of PDA models <<<
 - 2.1 Current models
 - 2.2 Upcoming models
 - 2.3 Discontinued models
- 3 Environmental Record <<<
- 4 See also
- 5 References <
- 6 External links <<<

History

 PALM

Palm Co
Hawkins,
and Ed C
invention of the Palm Pilot. The company was started

Palm is headed by *person*

business

Palm founded *organization*

Palm is a major company in *geographical region*

organization

Palm is legally incorporated in *political entity*

The main business activity of Palm occurs at *geographical region*

<http://palm.com> is the URL for Palm's homepage.

[Employees](#) < 1,050 (2008)^[1]

(generateFormulasForElements-TermIsa **PubliclyHeldCorporation**
(TheSet **stockTickerSymbol**))

Palm, Inc.

From Wikipedia, the free encyclopedia

Palm, Inc. is a personal digital assistant manufacturer headquartered in Sunnyvale, California, producing products such as the Zire, Tungsten, LifeDrive. Previous product lines include Palm OS and Palm VII. While their older devices run the Treo run Windows Mobile operating system, Palm webOS runs on Palm OS Garnet.^[2]

Contents [hide]

- 1 History
- 2 List of PDA models
 - 2.1 Current models
 - 2.2 Upcoming models
 - 2.3 Discontinued models
- 3 Environmental Record
- 4 See also
- 5 References
- 6 External links

◀ Palm, Inc. ▶ (aka Palm)

About Basic Info Documentation Advanced Info Affiliations

Recently Added

- Samsung and Palm are competitors.
- Nokia and Palm are competitors.
- Palm's homepage is "http://palm.com".
- The headquarters of Palm are in Sunnyvale, CA.
- Palm was founded by Donna Dubinsky.
- Palm was founded by Jeff Hawkins.
- Ed Colligan is Palm's CEO.

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Industry Computer hardware and software

Products Palm Pre, Z22, Tungsten E2, TX, Treo 650, Treo 700p, Treo 755p, Treo 670, Treo 700w, Treo 700wx, Treo 750, Centro, Treo 660

Revenue ▼ US\$ 1.22 billion

Employees 1,050 (2008)^[1]

PALM

and Ed Colligan's invention of the Palm Pilot. The company was started

(generate Formula For Elements Term Inc PubliclyHeldCorporation

Inferred Index order by: filters: index vie

Palm

From Wikipe

Browsing Editing

Palm, Inc

headquar

products s

LifeDrive.

and Palm

of the Tre

operating

Palm OS

All Assertions (83) close

all

via PalmInc (23)

isa (4) +

codeMapping arg3 (2)

companyHasCEO

companyHasCEO-SKSI

competitors arg2 (3) +

hasHeadquartersInRegion

homepage

nameString (2)

programAuthor arg2

rdURI (2)

rdURIInNamespace

relationAllInstance arg3

soleMakerOfProductType

arg2

stockTickerSymbol

wikipediaArticleName

via TechnologyCompany

meetsSomeConstraintOfTopicTyp

(0)

Individual : PalmInc ⁽¹⁾

on the term

isa : Individual

isa : LegalCorporation

isa : HighTechManufacturingEnterprise

isa : PubliclyHeldCorporation

(codeMapping DBpedia-CMLS "<http://dbpedia.org/resource/Palm_Inc.>"

PalmInc)

(codeMapping DBpedia-CMLS "<http://dbpedia.org/resource/Palm%2C_Inc.>"

PalmInc)

companyHasCEO : M(InstanceNamedFn-Ternary "Ed Colligan" Person

"2b85305e-c786-492f-9e45-94f437c839fe")

companyHasCEO-SKSI : (InstanceNamedFn-Ternary "Ed Colligan" Person

"2b85305e-c786-492f-9e45-94f437c839fe")

M(competitors AppleInc PalmInc)

M(competitors Samsung PalmInc)

M(competitors Nokia PalmInc)

hasHeadquartersInRegion : M(CityNamedFn "Sunnyvale" California-State)

homepage : M"http://palm.com"

nameString : "Palm, Inc." "Palm"

(programAuthor WebOS PalmInc)

rdURI : "http://wikicompany.org/wiki/Special:URIResolver/Palm%2C_Inc."

rdURI : "http://dbpedia.org/resource/Palm%2C_Inc."

(rdURIInNamespace PalmInc DBpediaResourceNamespace "Palm%2C_Inc.")

(relationAllInstance madeBy PalmPre PalmInc)

(soleMakerOfProductType PalmPre PalmInc)

stockTickerSymbol : "PALM"

C

1 History

2 List of P

2.1 C

2.2 U

2.3 D

3 Environ

4 See als

5 Referer

6 Externa

PALM

Employees 1,050 (2008)



❖ *Home*

❖ *Contact us*

❖ *Reservation*

❖ *History*

❖ *Banquet*

❖ *Brussels*

❖ *Hotels & Access*

Main courses

(with choice)

Dish of the day

or Tartar steak, frites

or Stewed beef with gueuze sauce and frites

or Grilled salmon béarnaise

or Mussels in casserole, frites (in season, 600g)

Bruxelles Centre Ville - Mozilla Firefox 4.0 Beta 6

http://cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rxDDhYVgaQnGpP5w4O

Bruxelles Centre Ville

About Basic Info Similar **Advanced Info (5★)**

Bruxelles Centre Ville properly geographically subsumes La Grande Place.

Brussels, Belgium properly geographically subsumes Bruxelles Centre Ville.

Someone should visit the cafe *cafe* when visiting Bruxelles Centre Ville.

Someone should visit *Working* when visiting Bruxelles Centre Ville.

localized event

Not Understood

Which of the following describe 'Aux Armes de Bruxelles'?

restaurant space

Create Cancel

Focus on Go Show Cycle

Read yui.yahooapis.com

Aux Armes de Bruxelles - Mozilla Firefox 4.0 Beta 6

http://cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rxDDhYVgaQnGpP5w400s

Aux Armes de Bruxelles

About Basic Info Similar **Advanced Info (11)**

Aux Armes de Bruxelles has *type of dish* on the menu.

Aux Armes de Bruxelles serves *cuisine*.

chef is the chef at Aux Armes de Bruxelles.

sous-chef is sous-chef at Aux Armes de Bruxelles.

waitperson is waitperson at Aux Armes de Bruxelles.

Each shift at Aux Armes de Bruxelles have *non-negative integer* people working.

Work happens during *calendar day* from *time of day type* to *time of day type* in Aux Armes de Bruxelles.

localized event happens on from *time of day type* to *time of day type* at Aux Armes de Bruxelles.

The last part of the wikipedia URL for Aux Armes de Bruxelles is .

Aux Armes de Bruxelles is located in *spatial thing non situational*.

Focus on

Done

Aux Armes de Bruxelles - Mozilla Firefox 4.0 Beta 6

http://cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rxDDhYVgaQnGpP5w4OOs

Aux Armes de Bruxelles

About Basic Info Similar **Advanced Info (11)**

Aux Armes de Bruxelles has *type of dish* on the menu.

Aux Armes de Bruxelles serves *Belgian cuisine*.

chef is the chef at Aux Armes de Bruxelles.

sous-chef is sous-chef at Aux Armes de Bruxelles.

waitperson is waitperson at Aux Armes de Bruxelles.

Each shift at Aux Armes de Bruxelles have *non-negative integer* people working.

Work happens during *calendar day* from *time of day type* to *time of day type* in Aux Armes de Bruxelles.

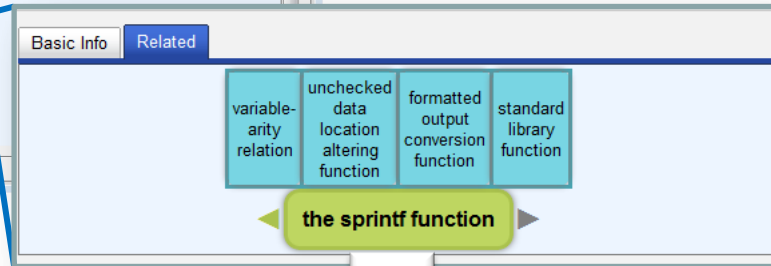
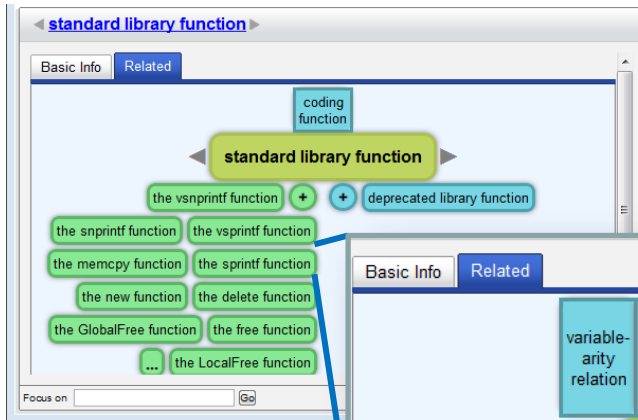
localized event happens on *Choose a value* from *time of day type* to *time of day type* at Aux Armes de Bruxelles.

The last part of the wikipedia URL for Aux Armes de Bruxelles is

Aux Armes de Bruxelles is located in *spatial thing non situational*.

Focus on Go Show Cycl

Read cure.cyc.com



sprintf function (aka the sprintf function)

Basic Info Related Advanced Info Libraries & Toolkits (4) Call Signature (5)

The sprintf function is part of Choose a value

The standard name of the sprintf function is sprintf

The sprintf function belongs to the operational category of thing

The sprintf function implements program action

Basic Info Related Advanced Info Libraries & Toolkits Call Signature (5)

The sprintf function is a Choose a value

The standard name for coding function parameter is

coding function parameter is Choose a value

The sprintf function returns bool as its value.

The sprintf function returns an Choose a value as its value.

Basic Info Related Advanced Info (4) Libraries & Toolkits Call Signature (5)

The sprintf function is a Choose a value

The standard name for Choose a value

The sprintf function returns Choose a value

The sprintf function returns an integer as its value.

function with a variable number of arguments

function with a fixed number of arguments

Some other thing

Basic Info Related Advanced Info (11) Libraries & Toolkits (4) Call Signature (5)

For the sprintf function, argument number 2 specifies the output format.

For the sprintf function, argument number 3 specifies the information to be formatted, and so do optional further arguments.

For the sprintf function, argument number 3 specifies the information to be formatted.

The memory location altered by application of the sprintf function is given by the value of the function's argument number 1.

The sprintf function returns handle as its value.

The sprintf function returns a pointer as its result.

Argument number positive integer of the sprintf function takes a handle as its value.

Argument number positive integer of the sprintf function takes a pointer as its value.

Basic Info Related Advanced Info (4) Libraries & Toolkits Call Signature (6)

The sprintf function is a function with a variable number of arguments

The standard name for coding function parameter is

is Choose a value

The sprintf function returns bool as its value.

The sprintf function returns an integer as its value.

The sprintf function takes at least non-negative integer arguments.

natural gas - Google Chrome
cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rvVkaSpwpEbGdrcN5Y29ycA8

natural gas

Basic Info Related Advanced Info

fossil fuel organic matter naturally-occurring tangible substance

natural gas

pure natural gas
liquified petroleum gas

Focus on

natural gas - Google Chrome
cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rvVkaSpwpEbGdrcN5Y29ycA8

natural gas

Basic Info Related Advanced Info

The input elementary flow of the Non-renewable material resources in the production of inorganic substance of natural gas is scalar quantity.

Focus on

natural gas - Google Chrome
cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rvVkaSpwpEbGdrcN5Y29ycA8

natural gas

Basic Info Related Advanced Info

The input elementary flow of the Non-renewable material resources in the production of inorganic substance of natural gas is scalar quantity.

Not Understood

Which of the following describe 'Non-renewable material resources from ground'?

resource type

Focus on

natural gas - Google Chrome
cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rvVkaSpwpEbGdrcN5Y29ycA8

natural gas

Basic Info Related Advanced Info

The input elementary flow of the Non-renewable material resources from ground in the production of inorganic substance of natural gas is scalar quantity.

Inputs and Outputs

Inputs

natural gas - Google Chrome
cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rvVkaSpwpEbGdrcN5Y29ycA8

natural gas

Basic Info Related Advanced Info

The input elementary flow of the Non-renewable material resources from ground in the production of gypsum in the production of 1 kilogram of natural gas is scalar quantity.

natural gas - Google Chrome
cure.cyc.com:8080/ConceptSearch/edit.jsp?conceptid=Mx4rvVkaSpwpEbGdrcN5Y29ycA8

natural gas

Basic Info Related Advanced Info

The input elementary flow of the Non-renewable material resources from ground in the production of gypsum in the production of 1 kilogram of natural gas is 7.2967534899479E-5 kilograms.

The input elementary flow of the Non-renewable material resource from ground in the production of calcium carbonate in the production of 1 kilogram of natural gas is 0.00358024857309695 kg.

Focus on

Type Of Flow	Classification	Flow	Resulting amount
Elementary flow	Resources / Resources from air / Renewable material resources from air	air	0.0820646059790296 kg (Mass)
Elementary flow	Resources / Resources from ground / Non-renewable material resources from ground	bentonite	0.00204056887260158 kg (Mass)
Elementary flow	Resources / Resources from ground / Non-renewable energy resources from ground	brown coal: 11.9 MJ/kg	0.00590549292913802 MJ (Net calorific value)
Elementary flow	Resources / Resources from ground / Non-renewable material resources from ground	calcium carbonate	0.00358024857309695 kg (Mass)
Elementary flow	Resources / Resources from ground / Non-renewable material resources from ground	calcium chloride	2.4823223488554E-15 kg (Mass)
Elementary flow	Resources / Resources from ground / Non-renewable material resources from ground	fluorspar	3.24851341420822E-9 kg (Mass)
Elementary flow	Resources / Resources from water / Renewable material resources from water	ground water	-0.00218950778744398 kg (Mass)
Elementary flow	Resources / Resources from ground / Non-renewable material resources from ground	gypsum	7.2967534899479E-5 kg (Mass)
Elementary flow	Resources / Resources from ground / Non-renewable energy resources from ground	hard coal: 26.3 MJ/kg	0.03064399983426 MJ (Net calorific value)

<http://lca.jrc.ec.europa.eu>

Renaissance Artists



(SubcollectionOfWithRelationToFn
Artist activeDuringPeriod
TheRenaissance)

Bronze Age Farmers



(SubcollectionOfWithRelationToFn
Farmer activeDuringPeriod
TheBronzeAge)

Kind of **TimeInterval**

Noun Form: *not* plural

Kind of **Agent-Generic**

Noun form

Noun Compound Parsing

Attributive Adjective & Noun

Yellow Submarine → (SubcollectionWithRelationToFn
Submarine
mainColorOfObject
Yellow)


Sick Child → (SubcollectionWithRelationToFn
HumanChild
stateOfHealth
Sick)

Supporting Lexical Assertions:

(adjSemTrans Yellow-TheWord 0 RegularAdjFrame
(mainColorOfObject :NOUN YellowColor))

(adjSemTrans Sick-TheWord 0 RegularAdjFrame
(stateOfHealth :NOUN Sick))

Noun Phrase Parsing

S: An Afghan inquiry has said an attack in the heart of Kabul on Januar 

Test 

S:

Parsed: An Afghan inquiry has said an attack in the heart of Kabul on January 18, that left five dead and 38 others wounded, was ordered by an Afghan commander in Pakistan who was part of the Haqqani network - a group allied to the Taliban and al-Qaeda. [\[Again\]](#)

Test

```
<template>
  <nIPattern class="140080">the heart of $City#0</nIPattern>
  <cyclPattern>
    (#$equalSymbols ?D (#$DowntownFn $City#0))
  </cyclPattern>
  <variable>?D</variable>
  <type>#$Downtown</type>
</template>
```

S:



GO

Parsed: An Afghan inquiry has said an attack in the heart of Kabul on January 18, that left five dead and 38 others wounded, was ordered by an Afghan commander in Pakistan who was part of the Haqqani network - a group allied to the Taliban and al-Qaeda. [\[Again\]](#)

Test

selection



S:



GO

Parsed: An Afghan inquiry has said an attack in the heart of Kabul on January 18, that left five dead and 38 others wounded, was ordered by an Afghan commander in Pakistan who was part of the Haqqani network - a group allied to the Taliban and al-Qaeda. [\[Again\]](#)

Partial Parse:

E: Everything is identical to attack in the downtown area of Kabul, Afghanistan.

C: (equalSymbols ?ATTACK

(SubcollectionOfWithRelationToFn Attack-MilitaryOperation eventOccursAt
(DowntownFn CityOfKabulAfghanistan)))

Section: (Start:30 Len:28)

Parsed by EBMT using construction:

```
NL:["$AttackOnObject#0 in $Place#1"]
Logic:(#SequalSymbols ?ATTACK (#$SubcollectionOfWithRelationToFn $AttackOnObject#0 #SeventOccursAt $Place#1 ))
Var:?ATTACK
Type:AttackOnObject
Mt:#$CurrentWorldDataCollectorMt-NonHomocentric
InfP:CycAPI Inference Params needs toString method
```

Taking Advantage of Paraphrases

an attack in the heart of Kabul on January 18, that left five dead and 38 others wounded.

AttackOnObject, that left five dead and 38 others wounded,

c.f. *AttackOnObject* has killed five people and injured 38

```
<template>
  <nIPattern class="140060">$AttackOnObject#0 has killed $NonNegativeInteger#2 people and injured $NonNegativeInteger#3</nIPattern>
  <cyclPattern>(#$thereExists ?ATTACK
    ($$and
      ($$isa ?ATTACK $AttackOnObject#0)
      ($$relationInstanceExistsCount #$animalInjuredIn ?ATTACK #$Person $NonNegativeInteger#3)
      ($$relationInstanceExistsCount #$organismKilled ?ATTACK #$Person $NonNegativeInteger#2) ) )
  </cyclPattern>
  <type>#$CyclSentence-Assertible</type>
  <microTheory>#$CurrentWorldDataCollectorMt-NonHomocentric</microTheory>
  <inferenceMode type=":MINIMAL"/>
</template>
```

```
<template>
  <nIPattern class="140060">$AttackOnObject#0 , that left $NonNegativeInteger#2 dead and $NonNegativeInteger#3 others wounded
  </nIPattern>
  <cyclPattern>(#$thereExists ?ATTACK
    ($$and
      ($$isa ?ATTACK $AttackOnObject#0)
      ($$relationInstanceExistsCount #$animalWoundedIn ?ATTACK #$Person $NonNegativeInteger#3)
      ($$relationInstanceExistsCount #$organismKilled ?ATTACK #$Person $NonNegativeInteger#2) ) )
  </cyclPattern>
  <type>#$CyclSentence-Assertible</type>
  <microTheory>#$CurrentWorldDataCollectorMt-NonHomocentric</microTheory>
  <inferenceMode type=":MINIMAL"/>
</template>
```

Taking Advantage of Paraphrases

an attack in the heart of Kabul on January 18, that left five dead and 38 others wounded.

AttackOnObject, that left five dead and 38 others wounded,

c.f. *AttackOnObject* has killed five people and injured 38

```
<template>
  <nIPattern class="140060">$AttackOnObject#0 has killed $NonNegativeInteger#2 people and injured $NonNegativeInteger#3</nIPattern>
  <cyclPattern>(#$thereExists ?ATTACK
    ($$and
      ($$isa ?ATTACK $AttackOnObject#0)
      ($$relationInstanceExistsCount #$animalInjuredIn ?ATTACK #$Person $NonNegativeInteger#3)
      ($$relationInstanceExistsCount #$organismKilled ?ATTACK #$Person $NonNegativeInteger#2) ) )
  </cyclPattern>
  <type>#$CycLSentence-Assertible</type>
  <microTheory>#$CurrentWorldDataCollectorMt-NonHomocentric</microTheory>
  <inferenceMode type=":MINIMAL"/>
</template>
```

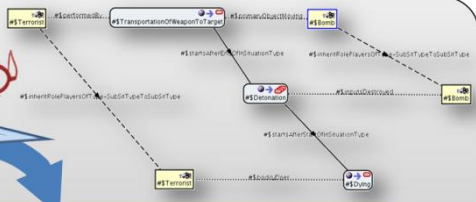
```
<template>
  <nIPattern class="140060">$AttackOnObject#0 , that left $NonNegativeInteger#2 dead and $NonNegativeInteger#3 others wounded
  </nIPattern>
  <cyclPattern>(#$thereExists ?ATTACK
    ($$and
      ($$isa ?ATTACK $AttackOnObject#0)
      ($$relationInstanceExistsCount #$animalInjuredIn ?ATTACK #$Person $NonNegativeInteger#3)
      ($$relationInstanceExistsCount #$organismKilled ?ATTACK #$Person $NonNegativeInteger#2) ) )
  </cyclPattern>
  <type>#$CycLSentence-Assertible</type>
  <microTheory>#$CurrentWorldDataCollectorMt-NonHomocentric</microTheory>
  <inferenceMode type=":MINIMAL"/>
</template>
```

Parsed: An Afghan inquiry has said an attack in the heart of Kabul, that left five dead and 38 others wounded, was ordered by an Afghan commander in Pakistan who was part of the Haqqani network - a group allied to the Taliban and al-Qaeda. [\[Again\]](#)

```
<microTheory>#$CurrentWorldDataCollectorMt-NonHomocentric</microTheory>
  <inferenceMode type=":MINIMAL"/>
</template>
```

Active Integration

Eind-2470: Bombing,
HumanKillingEvent



TerroristSuicideBombing

the site

"Five Israelis"

BombConstruction

BombMoving

Explosion

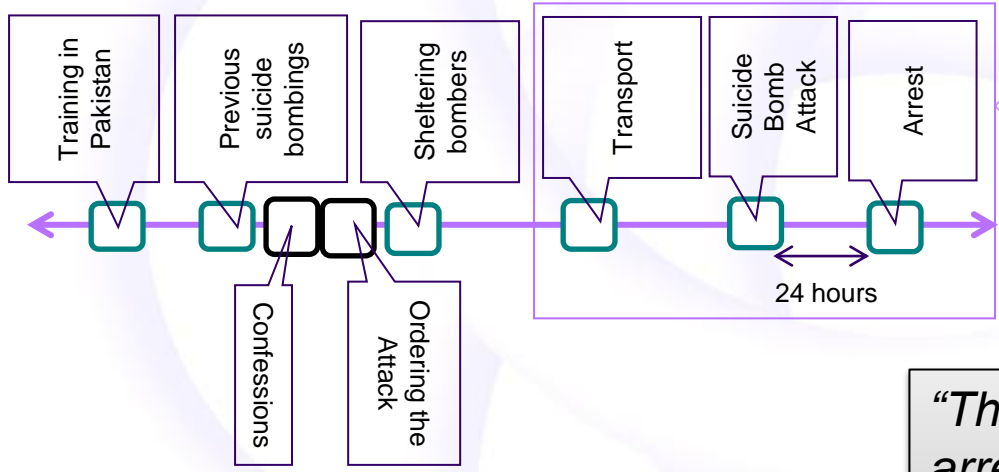
the bomb

the bomber

Death

IslamicJihad

CityOfTelAvivIsrael

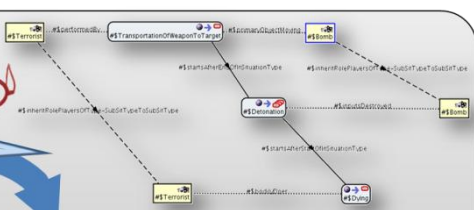


to prove: the transport in the bombing happened before the attack

"Their evidence comes from a man arrested 24-hours after the assault, who admitted he sheltered the suicide bombers and took them to some of their targets in Kabul"

Active Integration

Eind-2470: Bombing,
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the bomb

the bomber

Death

IslamicJihad

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Rules

- **Transport** of something to a place happens before the end of the thing transported (so, not after the attack).
- If there is one transport, of some X, as a sub-situation, and that X plays a required role in some other sub-situation, and the destination of the transport is near the location of the other sub-situation, then the transport happens before (in this case, the other sub-situation is the attack)

Existing Content

(properSubEventTypes TerroristSuicideBombing TransportationOfWeaponToTarget)

(properSubEventTypes TerroristSuicideBombing Detonation)

(properSubEventTypes TerroristSuicideBombing Dying)

(startsAfterEndOfInSituationType TerroristSuicideBombing Dying Detonation)

(startsAfterEndOfInSituationType TerroristSuicideBombing Detonation TransportationOfWeaponToTarget)

(startsAfterEndOfInSituationType TerroristSuicideBombing Detonation TransportationOfWeaponToTarget)

(inheritRolePlayers-SitTypeToSubSitType TerroristSuicideBombing perpetrator Dying bodilyDoer)

(inheritRolePlayersOfType-SubSitTypeToSubSitType TerroristSuicideBombing TransportationOfWeaponToTarget performedBy Dying bodilyDoer Terrorist)

(inheritRolePlayers-SitTypeToSubSitType TerroristSuicideBombing perpetrator TransportationOfWeaponToTarget doneBy)

"Islamic Jihad claimed responsibility for a February 25 suicide bombing in Tel Aviv that killed five Israelis."



Similar: Needed

(startsAfterEndOfInSituationType Bombing ClaimingResponsibility Detonation)

Causal Constraints:

(causes-SubSitTypeSubSitType Bombing Detonation Dying)

(requiresForRole Bombing Bomb deviceUsed)

(requiresForRole Detonation Bomb inputsDestroyed)

(requiresForRole TerroristSuicideBombing Person bodilyDoer)

We need these constraints, can they be read or learned?

Needs-based Ontology Extension

Role	Types	Examples
personKilled	People	vacationer, newlywed, bus rider, mouseketeer
eventOccursAt	Places	Police station, army recruiting center, souk, marquee
deviceUsed	Weapons	Suicide vest, boomerang, crossbow, bus bomb, shaped charge
killers	Agent	Somali youth, pirates, military doctor, rebel recruit

Haqqani network

From Wikipedia, the free encyclopedia

The **Haqqani network** is an independent insurgent group in [Afghanistan](#) and [Pakistan](#) that is closely allied with the [Taliban](#).^[1] [Maulvi Jalaluddin Haqqani](#) along with his son [Sirajuddin Haqqani](#) lead the Haqqani network which is based in [North Waziristan, Pakistan](#). The network is thought^[by whom?] to present one of the biggest threats to [NATO](#) and [United States forces](#) in [Afghanistan](#).^[2] Following [Wikileaks](#) July 2010 publication of 75,000 classified documents the public learned that Siraj Haqqani was in the tier one of the [International Security Assistance Force's Joint Prioritized Effects List](#) -- its "kill or capture" list.^[3]

- Techniques:
 - **Acquire candidates:**
 - Automatically acquire from dbPedia, or
 - Read from Wikipedia, or
 - Import from macro-readers, or
 - Fillers of templates, where there is evidence for effectiveness for type inference
 - **Confirmation** by human beings, or
 - by generate and test

