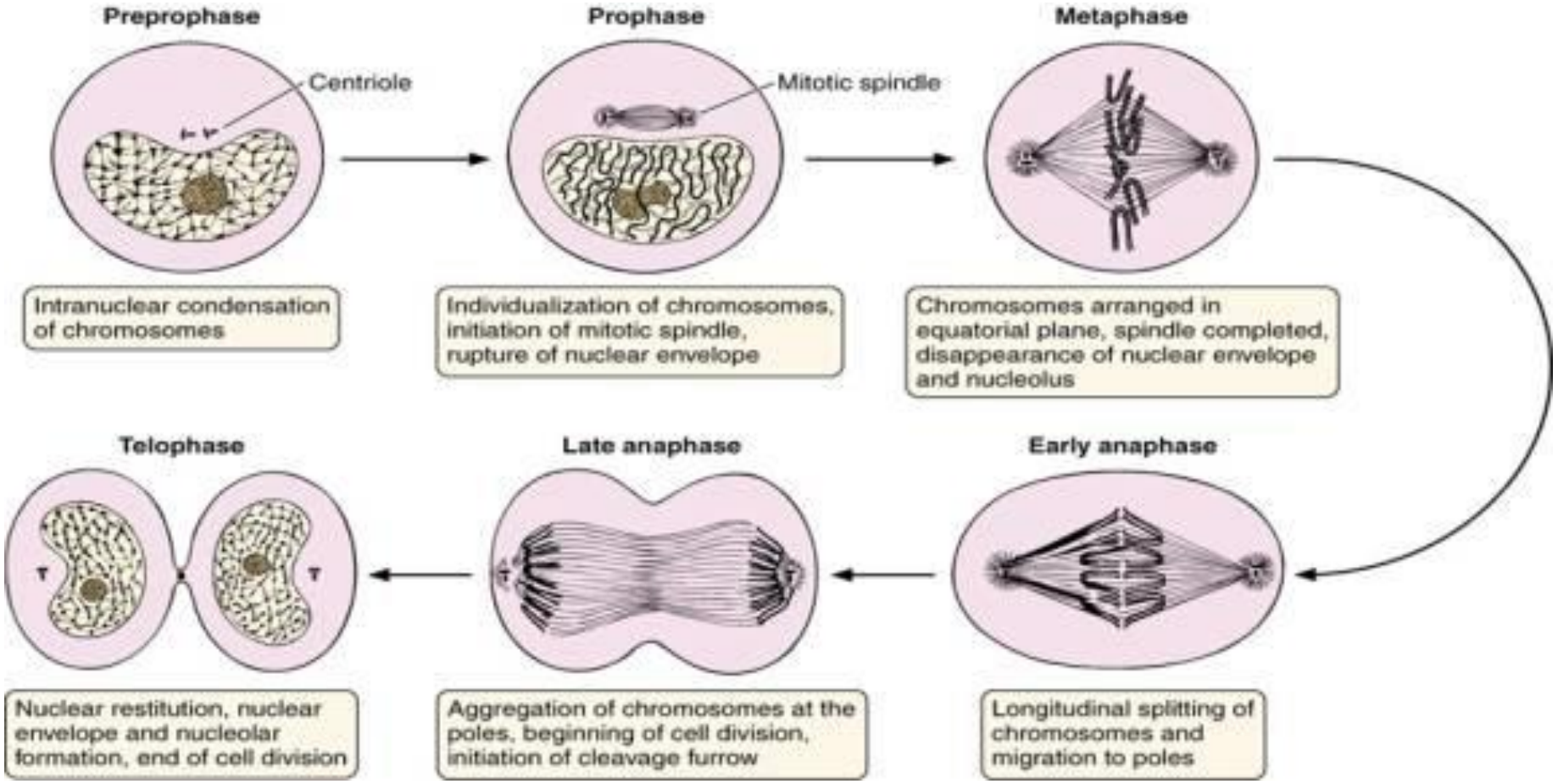
Embryontology

Barry Smith

Southampton, July 21, 2015

Old biology data (pre-Feb. 2001)



New biology data

MKVSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSF
YEDEKSGLIKVVKFRTGAMDRKRSFEKVVISVMVGKNVKKFLTFV
EDEPDFQGGPISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLF
YLNRGYYNELSFRVLERCHEIASARPNDSSTMRTFTDFVSGAPIV
RSLQKSTIRKYGYNLAPYMFLLLHVDELSIFSAYQASLPGEKKVDT
ERLKRDLCPRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALNF
GAGPRGGAGDEEDRSITNEEPIIPSVDEHGLKVCKLRSPNTPRRL
RKTLDAVKALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEVA
QETTLKDSYRITLVPSSDGISLLAFAGPQRNVYVDDTTRRIQLYTD
YNKNGSSEPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAFN
HDPWMDVVGFEDPNQVTNRDISRIVLYSYMFLNTAKGCLVEYAT
FRQYMRELPKNAPQKLNFREMRQGLIALGRHCVGSRFETDLYES
ATSELMANHSVQTGRNIYGVDFSLTSVSGTTATLLQERASERWIQ
WLGLESDYHCSFSSTRNAEDVDISRIVLYSYMFLNTAKGCLVEYA
TFRQYMRELPKNAPQKLNFREMRQGLIALGRHCVGSRFETDLYE
SATSELMANHSVQTGRNIYGVDFSLTSVSGTTATLLQERASERWI

How to do biology across the genome?

MKVSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRKRSFEKVVIS
VMVGKNVKKFLTFVEDEPDFQGGPISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLFYLNRGYYNELSFRVLER
CHEIASARPNDSSTMRTFTDFVSGAPIVRSLQKSTIRKYGYNLAPYMFLLLHVDELSIFSAYQASLPGEKKVDTERL
KRDLCPRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALNFGAGPRGGAGDEEDRSITNEEPIIPSVDEHGLKVC
KLRSPNTPRRLRKTLDAVKALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEVAQETTLKDSYRITLVPSSDGIS
LLAFAGPQRNVYVDDTTRRIQLYTDYNKNGSSEPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAFNHDPWM
DVVGFEDPNQVTNRDISRIVLYSYMFLNTAKGCLVEYATFRQYMRELPKNAPQKLNFREMRQGLIALGRHCVGSR
FETDLYESATSELMANHSVQTGRNIYGVDFSLTSVSGTTATLLQERASERWIQWLGLESDYHCSFSSTRNAEDVM
KVSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRKRSFEKVVISV
MVGKNVKKFLTFVEDEPDFQGGPISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLFYLNRGYYNELSFRVLERC
HEIASARPNDSSTMRTFTDFVSGAPIVRSLQKSTIRKYGYNLAPYMFLLLHVDELSIFSAYQASLPGEKKVDTERLK
RDLCPRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALNFGAGPRGGAGDEEDRSITNEEPIIPSVDEHGLKVCK
LRSPNTPRRLRKTLDAVKALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEVAQETTLKDSYRITLVPSSDGISLL
AFAGPQRNVYVDDTTRRIQLYTDYNKNGSSEPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAFNHDPWMD
VVGFEDPNQVTNRDISRIVLYSYMFLNTAKGCLVEYATFRQYMRELPKNAPQKLNFREMRQGLIALGRHCVGSRF
ETDLYESATSELMANHSVQTGRNIYGVDFSLTSVSGTTATLLQERASERWIQWLGLESDYHCSFSSTRNAEDVMK
VSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRKRSFEKVVISVM
VGKNVKKFLTFVEDEPDFQGGPISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLFYLNRGYYNELSFRVLERCH
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DLCPRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALNFGAGPRGGAGDEEDRSITNEEPIIPSVDEHGLKVCKL
RSPNTPRRLRKTLDAVKALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEVAQETTLKDSYRITLVPSSDGISLL
AFAGPQRNVYVDDTTRRIQLYTDYNKNGSSEPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAFNHDPWMD
VVGFEDPNQVTNRDISRIVLYSYMFLNTAKGCLVEYATFRQYMRELPKNAPQKLNFREMRQGLIALGRHCVGSRF
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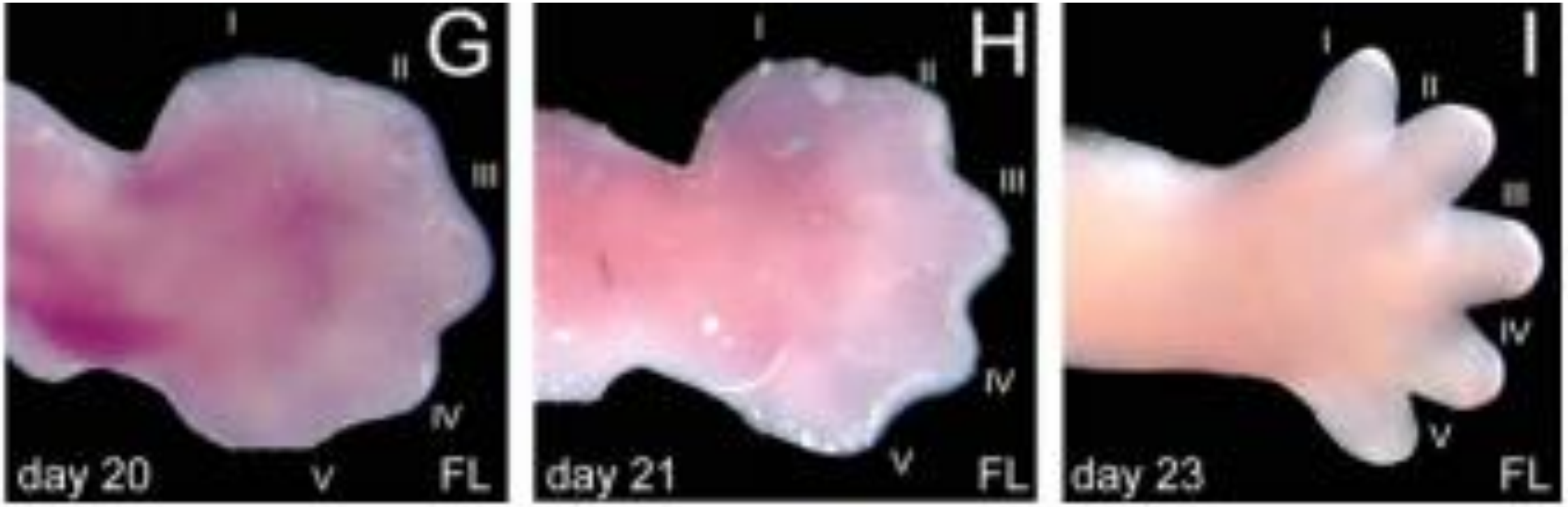
EIASARPNDSSTMRTFTDFVSGAPIVRSLQKSTIRKYGYNLAPYMFLLLHVDELSIFSAYQASLPGEKKVDTERLKR

how to link the kinds of phenomena represented here

or here

or here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MKVSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRK
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GAGF PRRLRKTLDAVKALLVSSCACTARDLD
IFDDM SLLAFAGPQRNVYVDDTTRRIQLYTDY
NKNG AFNHDPWMDVVGFEDPNQVTNRDIS
RIVLY EMRQGLIALGRHCVGSRFETDLYESA
TSELI RWIQWLGLESDYHCSFSSTRNAEDVV
AGEA FEFRDLHQLRLCYEIYMADTPSVAVQA
PPGYGKTELFHLPLIALASKGDVEYVSFLFVPYTVLLANCMIRLGRRGCLNVAPVRNFIEEGYDGVTDL
YVGIYDDLASTNFTDRIAAWENIVECTFRTNNVKLGYLIVDEFHNFETEVYRQSQFGGITNLDFDAFEK
AIFLSGTAPEAVADAALQRIGLTGLAKKSMDINELKRSEDLSRGLSSYPTRMFNLIKEKSEVPLGHVHKI
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ASTNATTNASTNATTNSSTNATTTASTNVRTSATTTASINVRTSATTTESTNSSTNATTTESTNSSTNA
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CPEGVFTQYGLCKGCQKMFELCVCWAGQKVSYRRIAWEALAVERMLRNDEEYKEYLEDIEPYHGDP
VGYLKYFSVKRREIYSQIQRNYAWYLAITRRRETISVLDSTRGKQGSQVFRMSGRQIKELYFKVWSNL
RESKTEVLQYFLNWDEKKCQEEWEAKDDTVVVEALEKGGVFQRLRSMTSAGLQGPQYVKLQFSRH
HRQLRSRYELSLGMHLRDQIALGVTPSKVPHWTAFLSMLIGLFYNKTFRQKLEYLLEQISEVWLLPHW
LDLANVEVLAADDTRVPLYMLMVAVHKELDSDDVPDGRFDILLCRDSSREVGELIGLFYNKTFRQKLE
YLLEQISEVWLLPHWLDLANVEVLAADDTRVPLYMLMVAVHKELDSDDVPDGRFDILLCRDSSREVG
ELIGLFYNKTFRQKLEYLLEQISEVWLLPHWLDLANVEVLAADDTRVPLYMLMVAVHKELDSDDVPDG

to the kinds of data represented here?

Answer

Create a controlled logically structured consensus vocabulary

– called an “ontology” –

representing the types of entities (things, processes, …) scientists are [still] interested in, and use the terms in this ontology to tag or annotate data about these entities

Analysis of microRNA expression profile by small RNA sequencing in Down syndrome fetuses

Authors: Yong Xu, Wuxian Li, Xueyan Liu, Hualin Ma, Zhiguang Tu, ✉ Yong Dai

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View Affiliations

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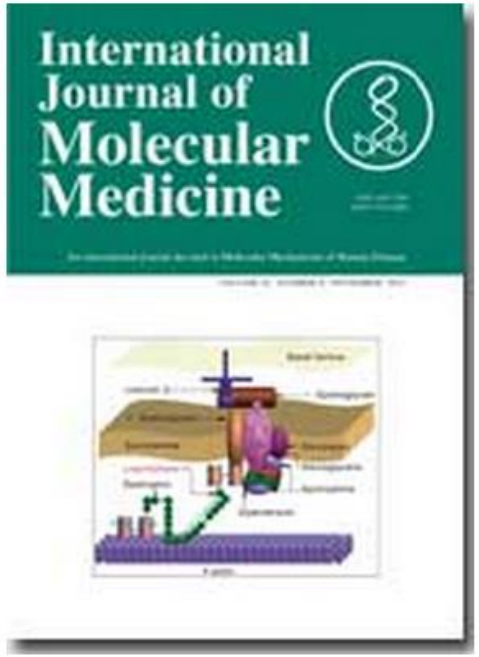
Pages: 1115-1125 **DOI:** 10.3892/ijmm.2013.1499



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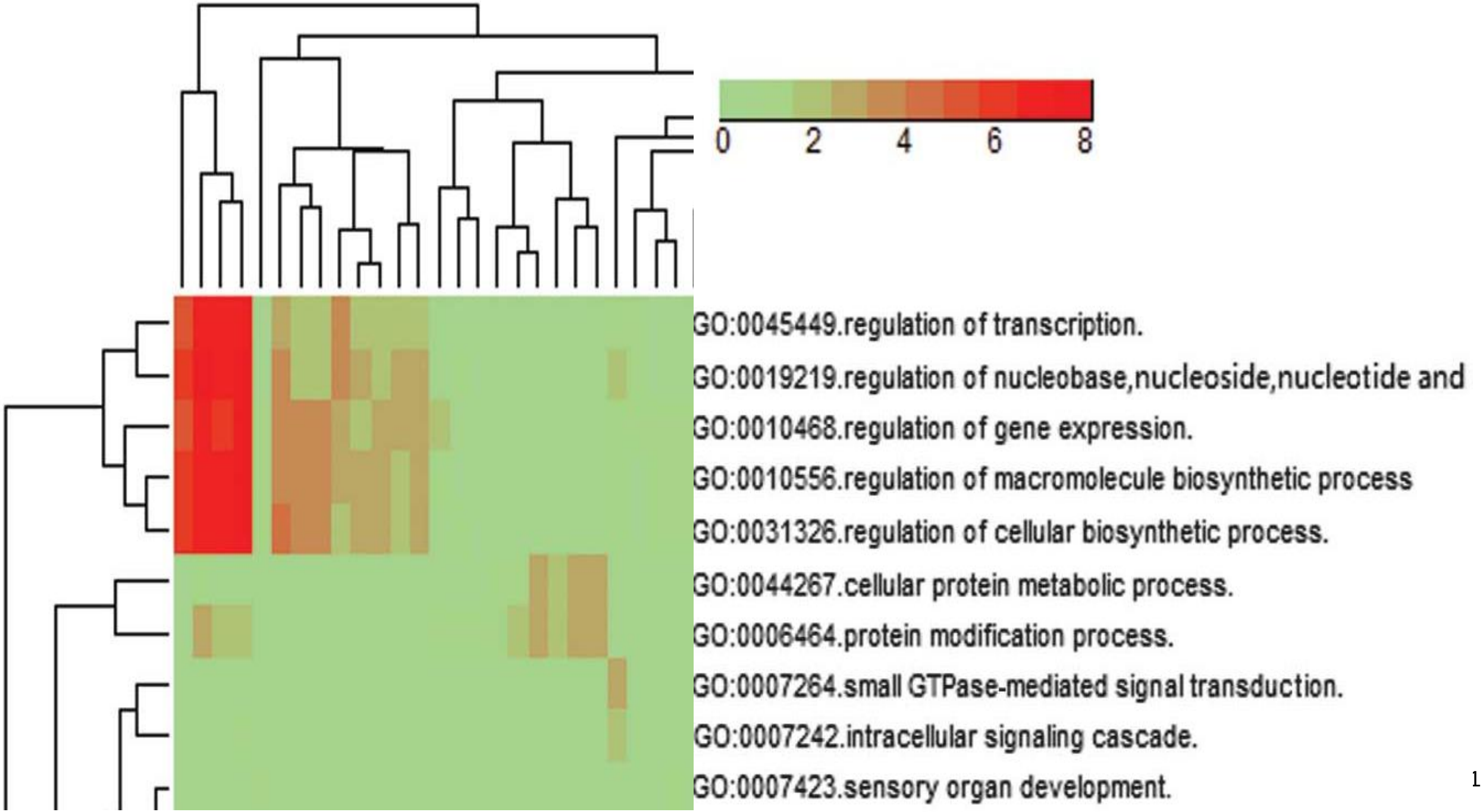
0
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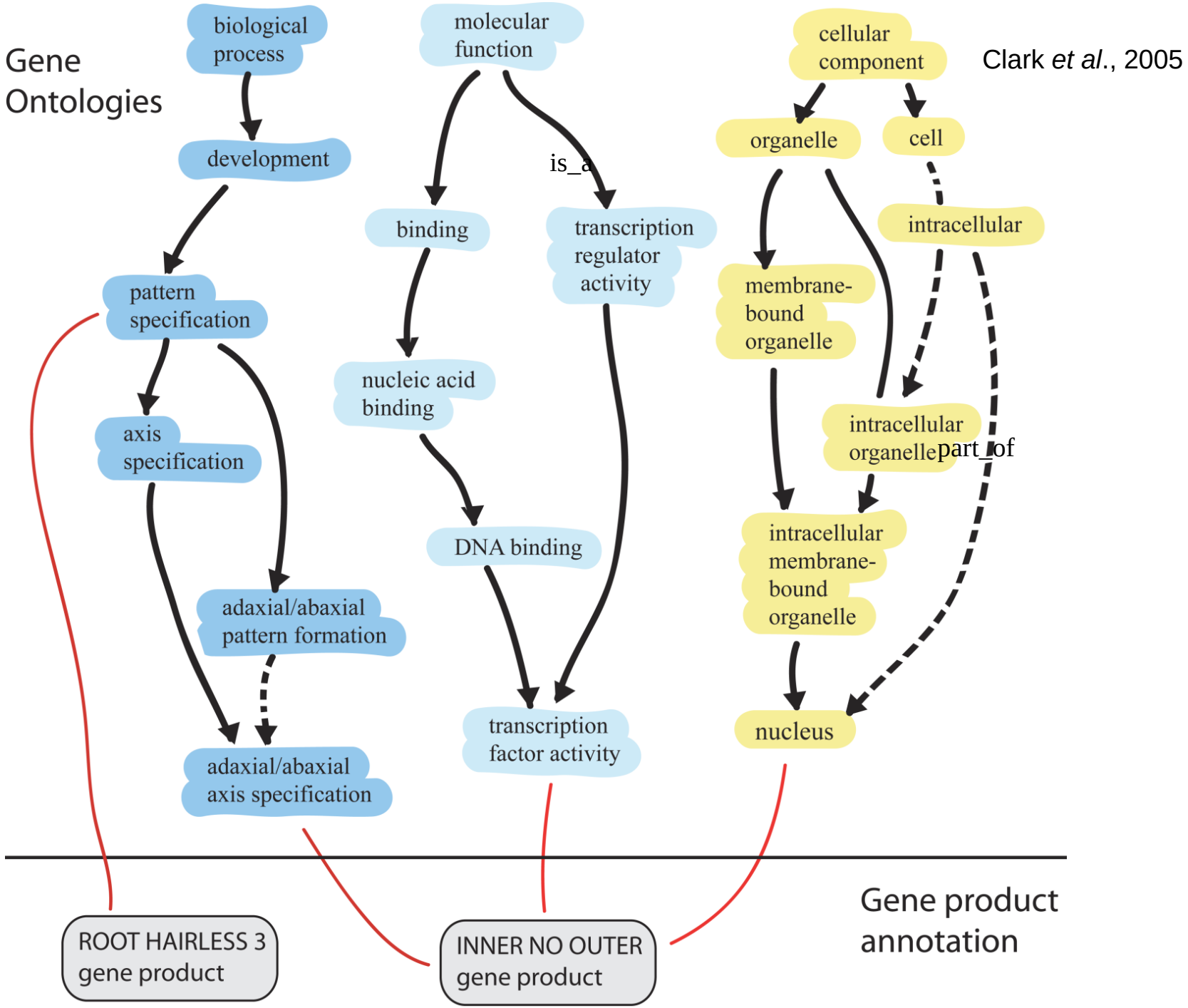
GO:0045449.regulation of transcription.
GO:0019219.regulation of nucleobase,nucleoside,nucleotide and
GO:0010468.regulation of gene expression.
GO:0010556.regulation of macromolecule biosynthetic process
GO:0031326.regulation of cellular biosynthetic process.
GO:0044267.cellular protein metabolic process.
GO:0006464.protein modification process.
GO:0007264.small GTPase-mediated signal transduction.
GO:0007242.intracellular signaling cascade.
GO:0007423.sensory organ development.

COMMENTARY

Nature Genetics **25**, 25 - 29 (2000)
doi:10.1038/75556

Gene Ontology: tool for the unification of biology

Michael Ashburner[1, 5], Catherine A. Ball[3, 5], Judith A. Blake[4, 5], David Botstein[3, 5], Heather Butler[1, 5], J. Michael Cherry[3, 5], Allan P. Davis[4, 5], Kara Dolinski[3, 5], Selina S. Dwight[3, 5], Janan T. Eppig[4, 5], Midori A. Harris[3, 5], David P.


Gene Ontologies
biological process
molecular function
cellular component
Clark *et al*., 2005
development
is_a
organelle
cell
binding
transcription regulator activity
intracellular
pattern specification
membrane-bound organelle
nucleic acid binding
intracellular organelle
part_of
axis specification
DNA binding
intracellular membrane-bound organelle
adaxial/abaxial pattern formation
transcription factor activity
nucleus
adaxial/abaxial axis specification
ROOT HAIRLESS 3 gene product
INNER NO OUTER gene product
Gene product annotation

GO provides *species neutral* terms for tagging biological data

it thereby enables data deriving from experiments on model organisms (mouse, fish, fly, …) to be used to derive and test hypotheses about human health and disease

Example: Embryo implanation
http://amigo.geneontology.org/amigo/

Term Information

Accession	GO:0007566
Name	embryo implantation
Ontology	biological_process
Synonyms	blastocyst implantation
Definition	Attachment of the blastocyst to the uterine lining. *Source:* GOC:isa_complete, http://www.medterms.com
Comment	None
History	See term history for GO:0007566 at QuickGO
Subset	None
Community	**GN** Add usage comments for this term on the GONUTS wiki.
Related	Link to all **genes and gene products** associated to embryo implantation. Link to all direct and indirect **annotations** to embryo implantation. Link to all direct and indirect **annotations download** (limited to first 10,000) for embryo implantation.
Feedback	Contact the GO Helpdesk if you find mistakes or have concerns about the data you find here.

+ document_category: annotation

+ regulates_closure: GO:0007566

No current user filters.

- Source
- Assigned by
- Ontology (aspect)
- Evidence type
- PANTHER family
- Qualifier
- Taxon

The top (21) redundant fields are not shown

Boreoeutheria (354) + -

Eutheria (354) + -

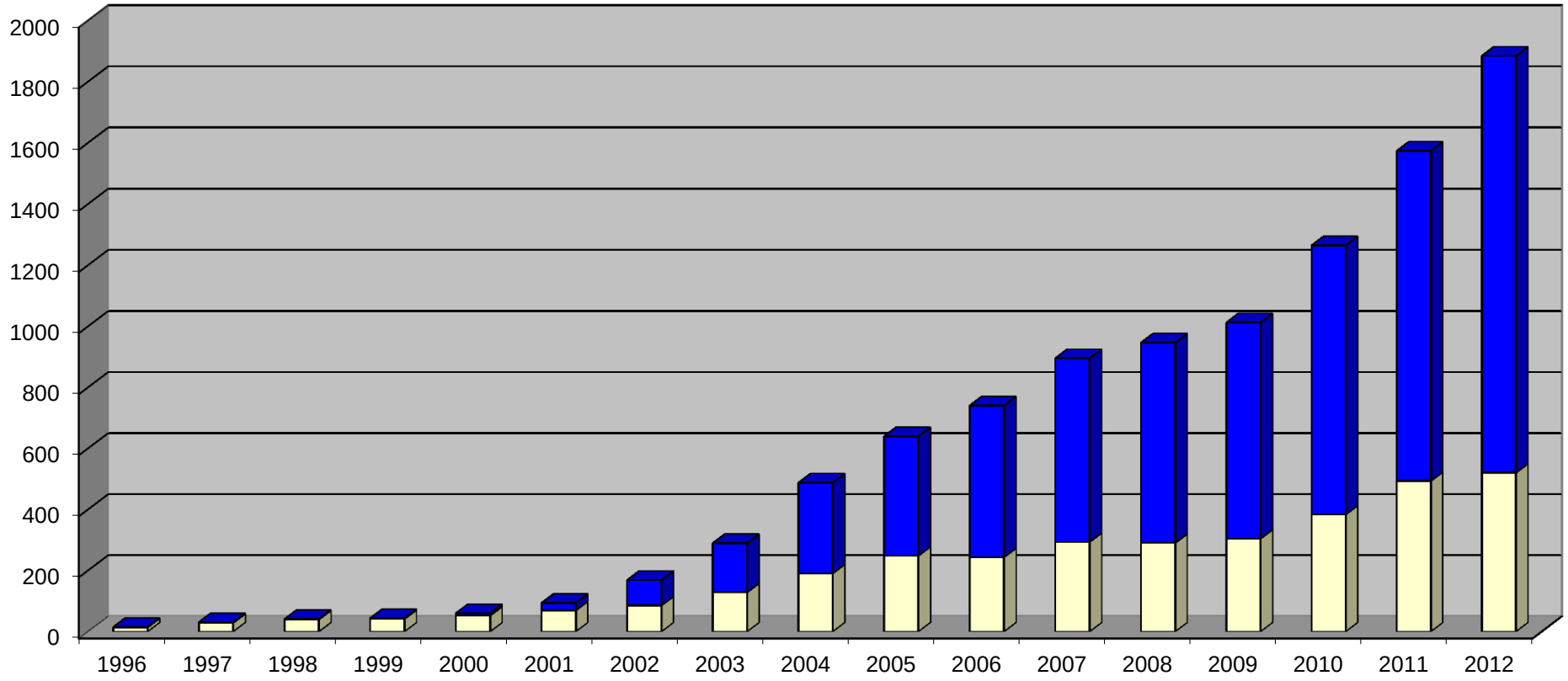
Mammalia (354) + -

more...

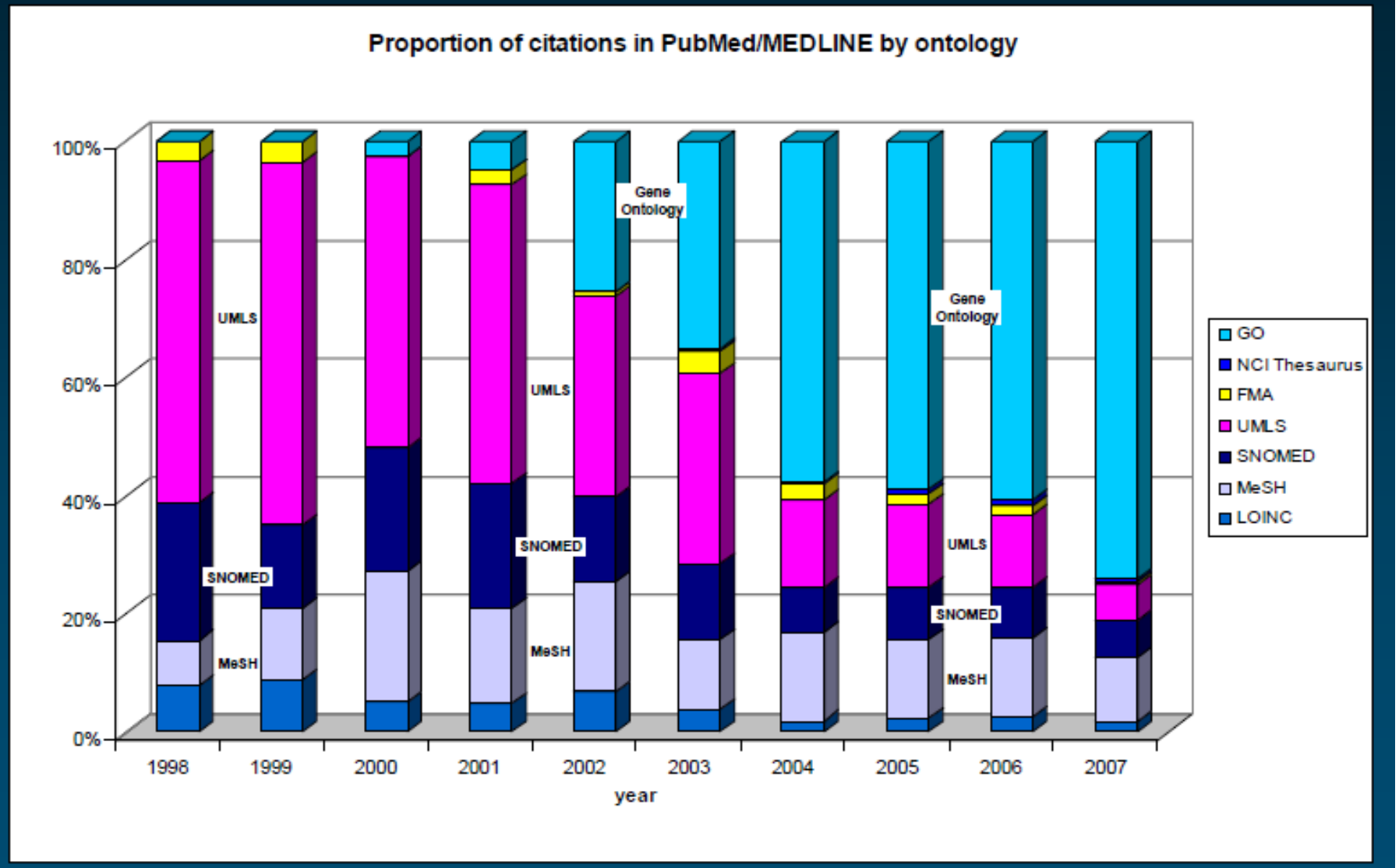
- Direct annotation
- Inferred annotation
- Annotation extension

Gene/product	Gene/product name	Qualifier	Direct annotation	Annotation extension	Assigned by	Taxon	Evidence
MST1	Uncharacterized protein		embryo implantation		Ensembl	Canis lupus familiaris	IEA
OOEP	Oocyte-expressed protein		embryo implantation		Ensembl	Canis lupus familiaris	IEA
OOEP	Oocyte-expressed protein homolog		embryo implantation		Ensembl	Bos taurus	IEA
PTGIS	Prostacyclin synthase		embryo implantation		Ensembl	Bos taurus	IEA
FKBP4	Uncharacterized protein		embryo implantation		Ensembl	Canis lupus familiaris	IEA
TIMP1	Metalloproteinase inhibitor 1		negative regulation of trophoblast cell migration		Ensembl	Canis lupus familiaris	IEA
NLRP5	Uncharacterized protein		embryo implantation		Ensembl	Canis lupus familiaris	IEA

Uses of ‘ontology’ in PubMed abstracts

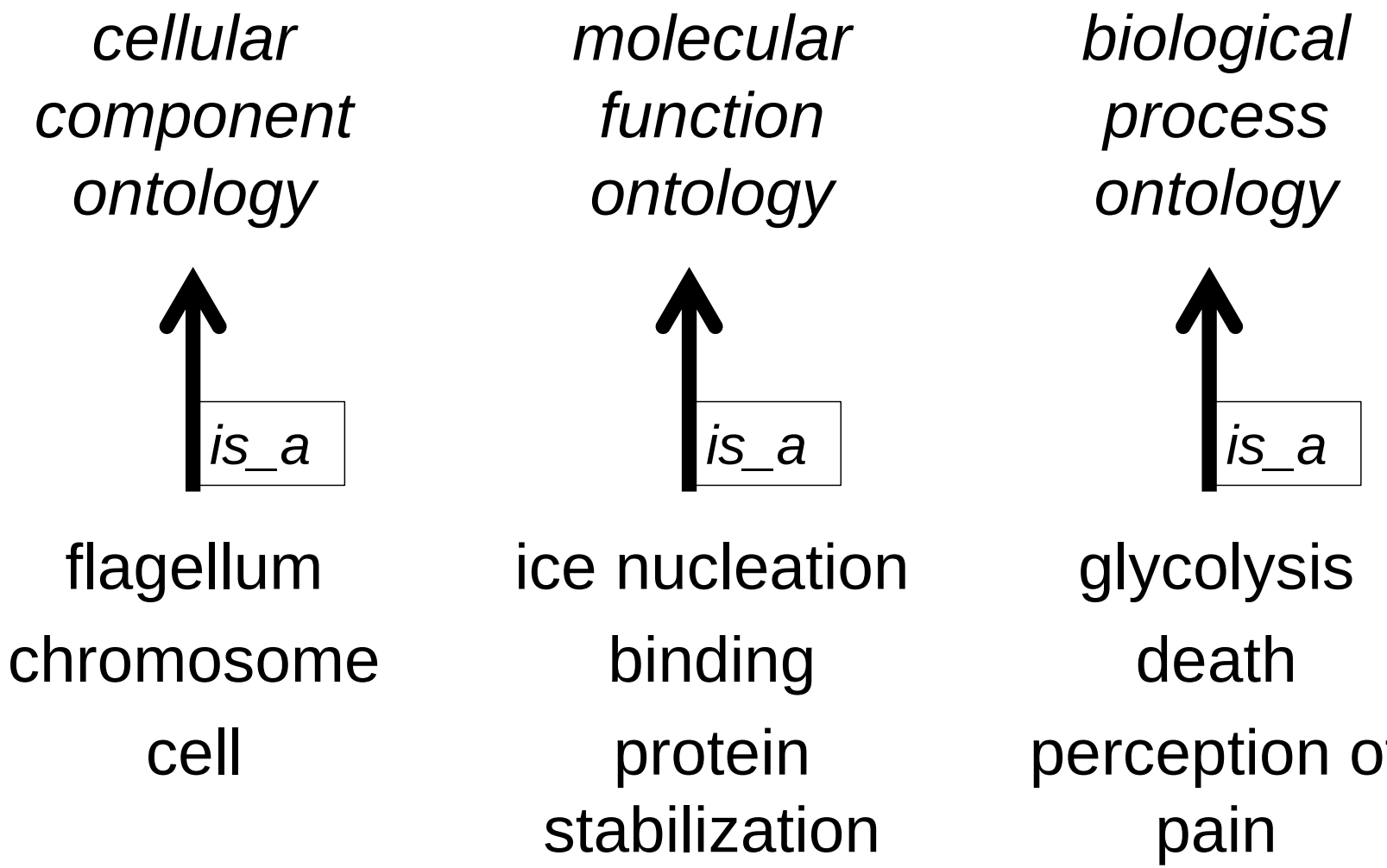


By far the most successful: GO (Gene Ontology)



[Bodenreider, YBMI 2008]

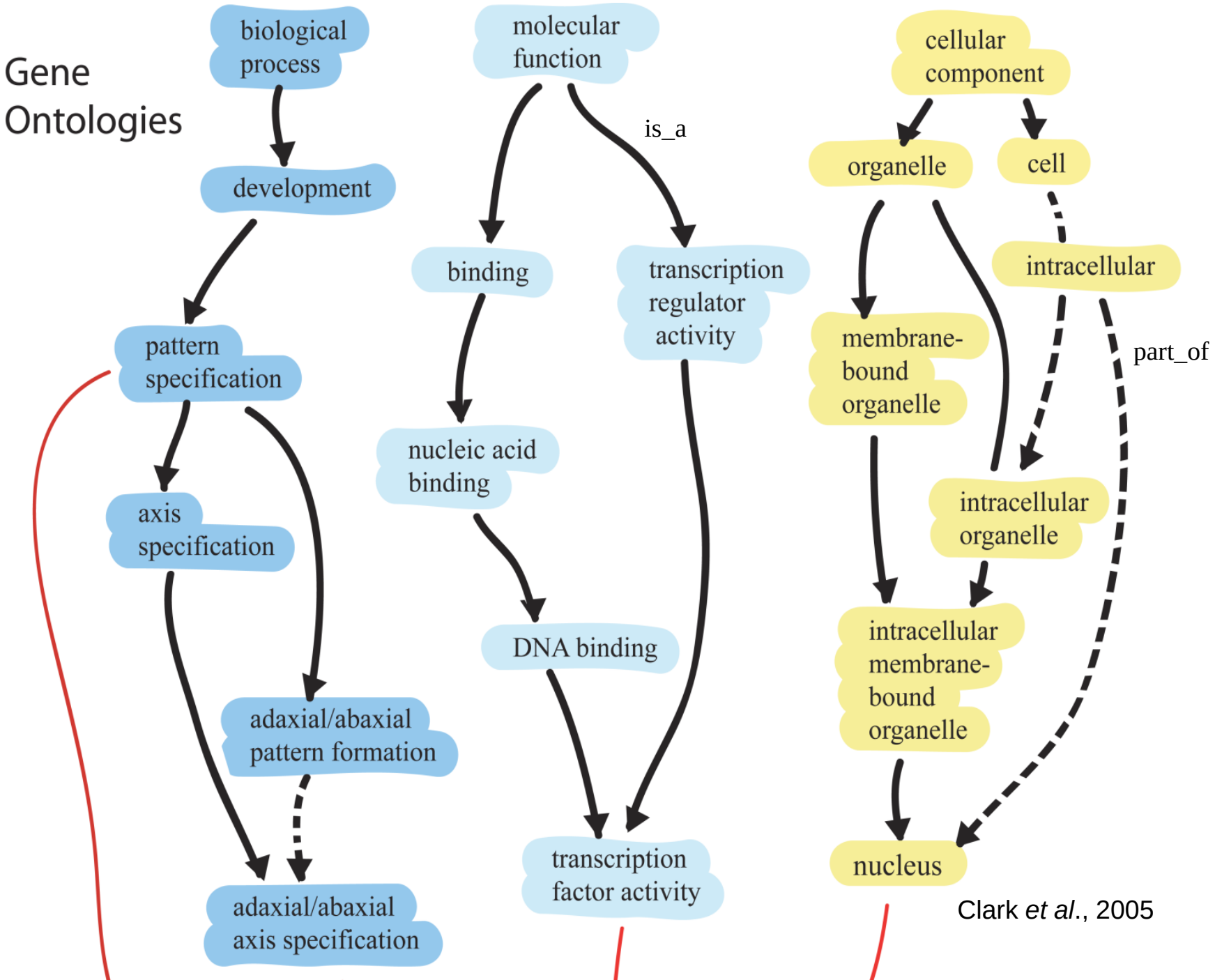
GO divided into three term hierarchies



When a new gene or gene product is discovered

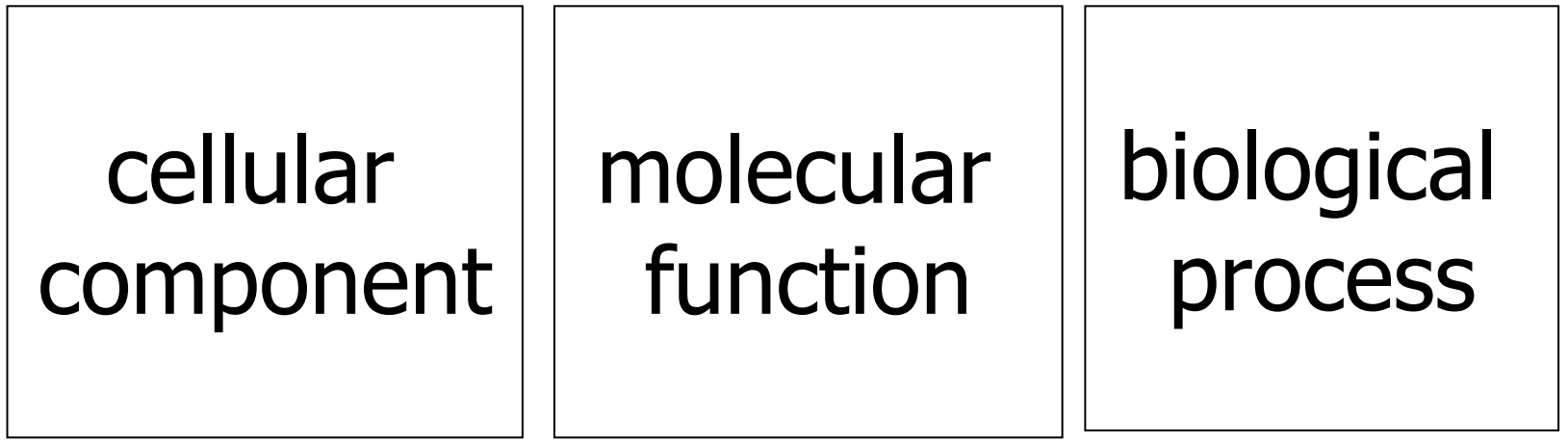
we first try to answer three questions:

- where is it located in the cell?
- what is its molecular function?
- what biological processes does the exercise of this function contribute to?



Clark *et al.*, 2005

Gene Ontology

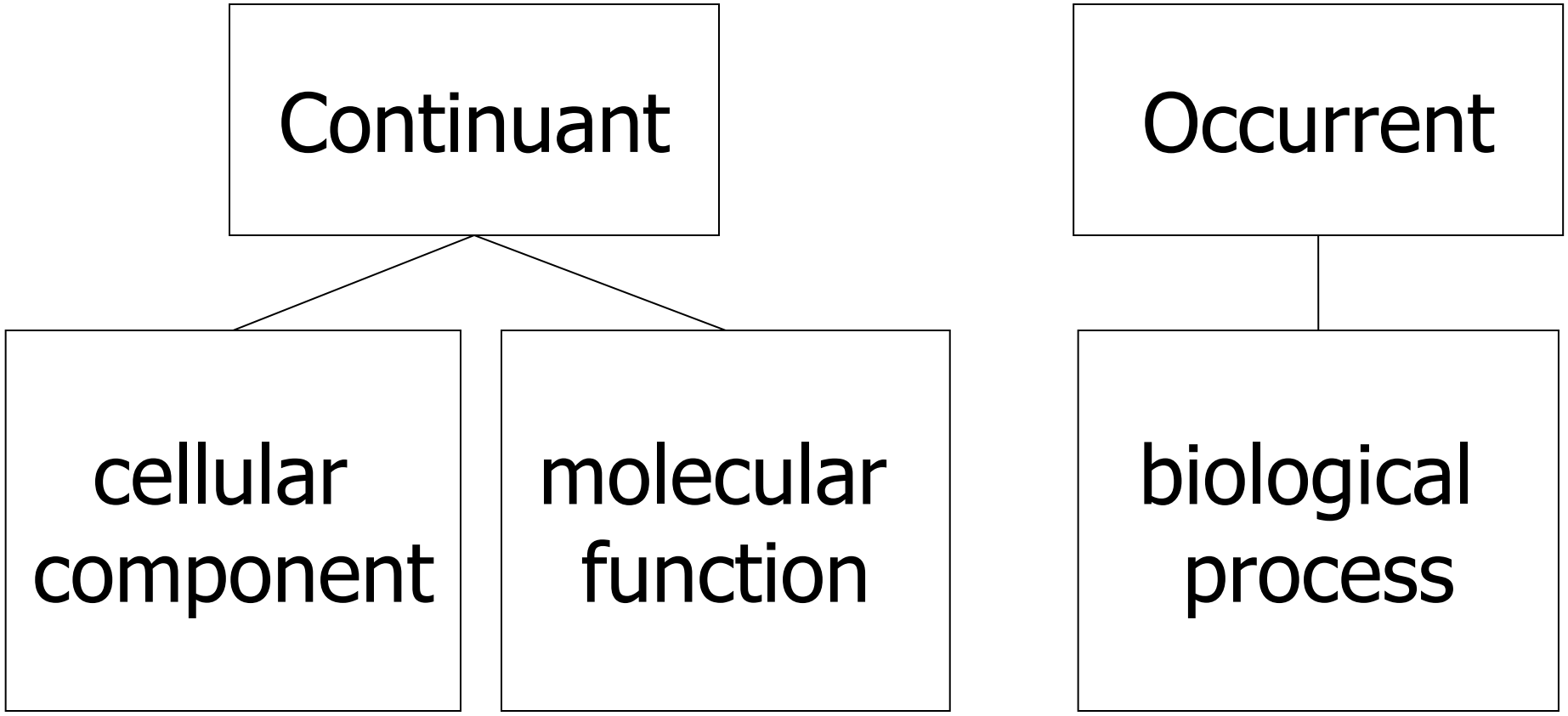


Two ways of existing in time

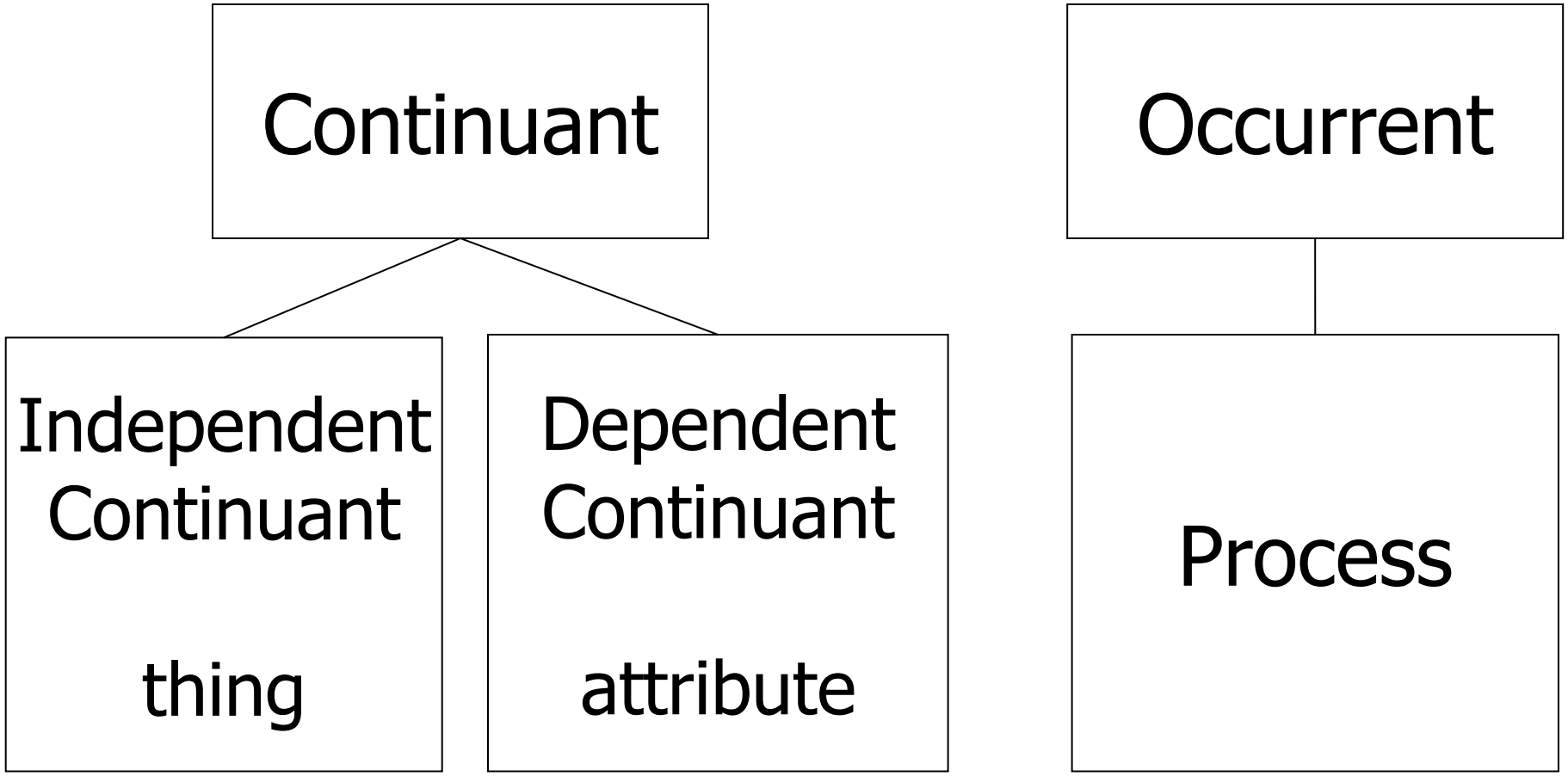
You are a continuant – an entity that continues

Your *life* is an occurrent – a process that occurs

Gene Ontology



Top level ontology defined by GO



Extending GO to provide representations of further sorts of biological entities

proteins, species, populations, diseases, symptoms, developmental anatomy, experimental processes, behavior …

The Open Biological and Biomedical Ontologies (OBO) Foundry

nature biotechnology

Perspective

Nature Biotechnology **25**, 1251 - 1255 (2007)
Published online: 7 November 2007 | doi:10.1038/nbt1346

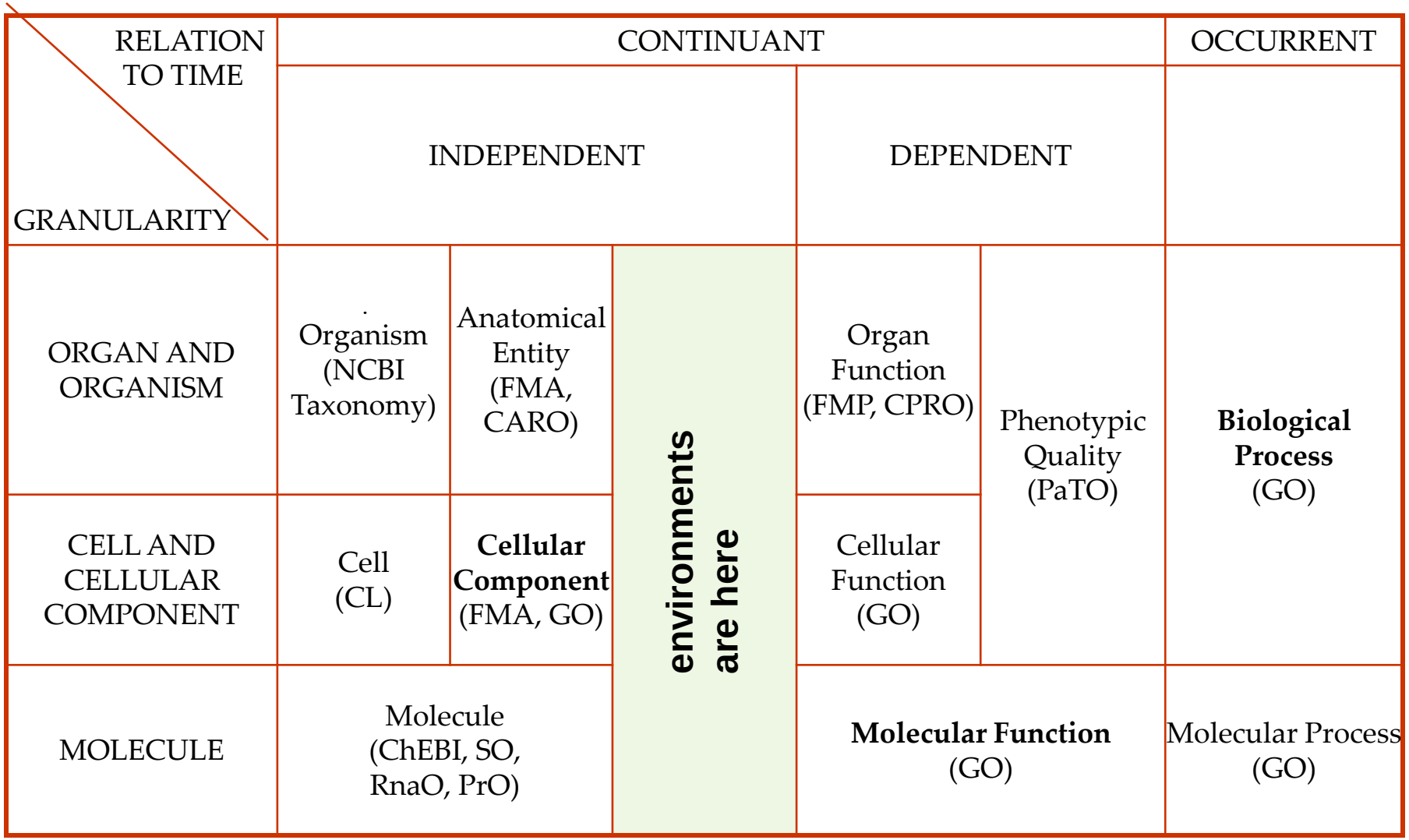
The OBO Foundry: coordinated evolution of ontologies to support biomedical data integration

Barry Smith[1], Michael Ashburner[2], Cornelius Rosse[3], Jonathan Bard[4], William Bug[5], Werner Ceusters[6], Louis J Goldberg[7], Karen Eilbeck[8], Amelia Ireland[9], Christopher J Mungall[10], The OBI Consortium[11], Neocles Leontis[12], Philippe Rocca-Serra[9], Alan Ruttenberg[13], Susanna-Assunta Sansone[9], Richard H

RELATION TO TIME / GRANULARITY	CONTINUANT				OCCURRENT
	INDEPENDENT		DEPENDENT		
ORGAN AND ORGANISM	Organism (NCBI Taxonomy)	Anatomical Entity (FMA, CARO)	Organ Function (FMP, CPRO)	Phenotypic Quality (PaTO)	**Biological Process** (GO)
CELL AND CELLULAR COMPONENT	Cell (CL)	**Cellular Component** (FMA, GO)	Cellular Function (GO)		
MOLECULE	Molecule (ChEBI, SO, RnaO, PrO)		**Molecular Function** (GO)		Molecular Process (GO)

Original OBO Foundry ontologies

(Gene Ontology in yellow)



Environment Ontology (including intra-organismal environments, such as the gut and oral cavities)

JOURNAL OF BIOMEDICAL SEMANTICS

IMPACT FACTOR 2.26

This article is part of the series Biomedical Ontologies.

Research

Open Access

The environment ontology: contextualising biological and biomedical entities

Pier Luigi Buttigieg[1]*, **Norman Morrison**[4], **Barry Smith**[3], **Christopher J Mungall**[2], **Suzanna E Lewis**[2] and **the ENVO Consortium**

* Corresponding author: Pier L Buttigieg pbuttigi@mpi-bremen.de

Author Affiliations

JOURNAL OF BIOMEDICAL SEMANTICS

IMPACT FACTOR 2.26

This article is part of the series Biomedical Ontolog

Research

Ontology for General Medical Science

Summary Classes Properties Notes Mappings Widgets

Jump To:

- generically dependent continuant
- independent continuant
  - immaterial entity
  - material entity
    - congenital malformation
    - **disorder**
    - extended organism
    - fiat object
    - injury
    - object
    - object aggregate
    - organism population
    - pathological anatomical struct
    - pathological formation

Details | Visualization | Notes (0) | Class Ma

Preferred Name	disorder
ID	http://purl.obolibrary.org/
curator note	creation date: 2009-06-23
definition	A material entity which is cl physical basis of disease.
definition editor	Albert Goldfain

Ontology for General Medical Science

Summary Classes Properties Notes Mappings Widgets

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- independent continuant
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  - material entity
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    - **disorder**
    - extended organism
    - fiat object
    - injury
    - object
    - object aggregate
    - organism population
    - pathological anatomical struct
    - pathological formation

Details | Visualization | Notes (0) | Class Ma

Preferred Name	disorder
ID	http://purl.obolibrary.org/c

Definition. A material entity which is clinically abnormal and part of an extended organism.

Ontology for General Medical Science

Summary Classes Properties Notes Mappings Widgets

Jump To:

- continuant
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    - material entity
      - congenital malformation
      - disorder
      - **extended organism**
      - fiat object
      - injury
      - object
      - object aggregate
      - organism population
      - pathological anatomical struct

Details | Visualization | Notes (0) | Class M

Preferred Name	extended organism
ID	http://purl.obolibrary.org/
curator note	creation date: 2010-01-25
definition	An object aggregate consis overlapping the organism,
definition editor	Albert Goldfain
definition source	http://code.google.com/p/
label	extended organism
prefixIRI	OGMS:0000087

Ontology for General Medical Science

Summary Classes Properties Notes Mappings Widgets

Jump To:

- continuant
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  - independent continuant
    - immaterial entity
    - material entity
      - congenital malformation
      - disorder
      - **extended organism**
      - fiat object
      - injury
      - object
      - object aggregate
      - organism population
      - pathological anatomical struct

Details | Visualization | Notes (0) | Class M

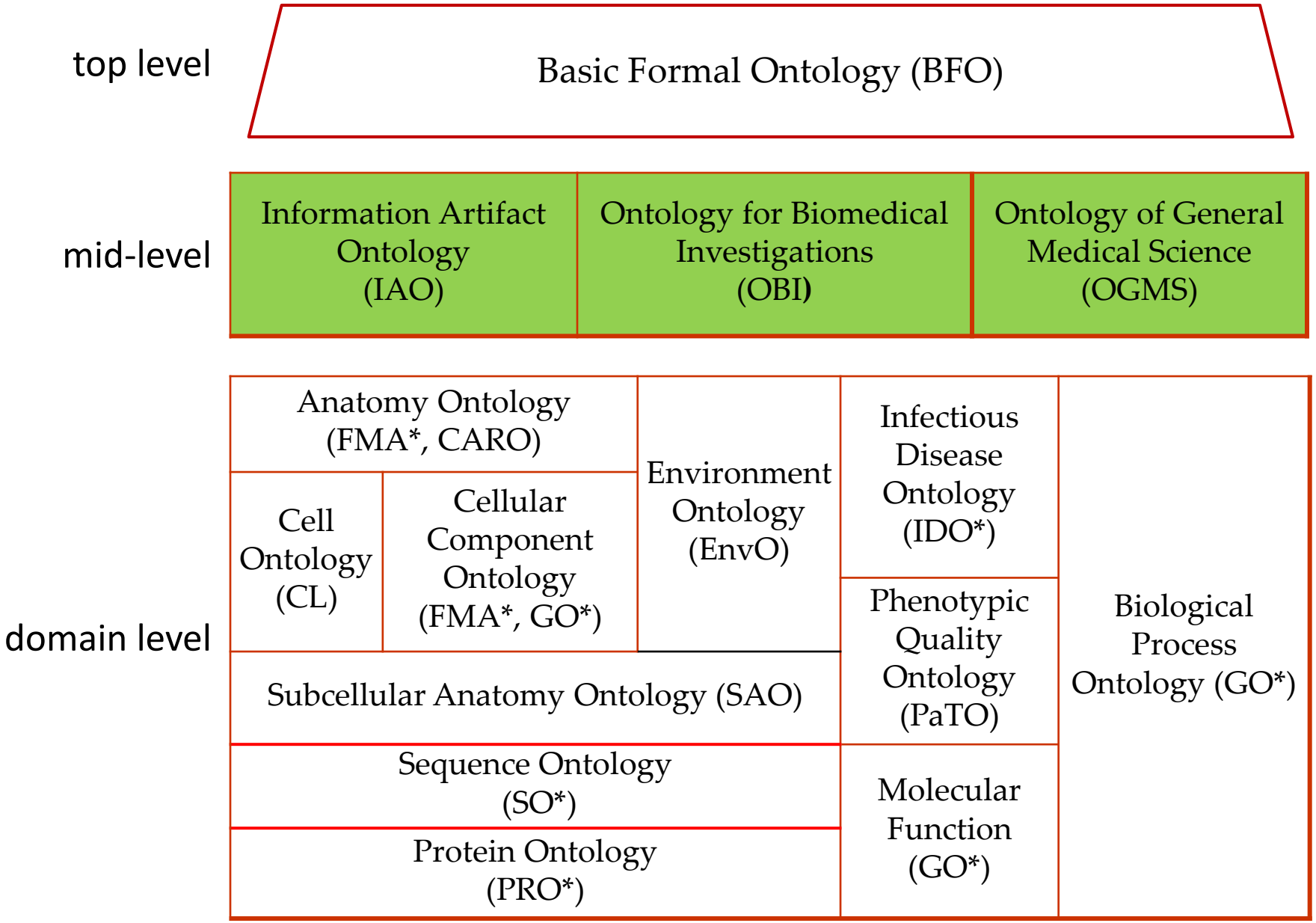
Preferred Name	extended organism
ID	http://purl.obolibrary.org/

Defintion: An object aggregate consisting of an organism and all material entities located within the organism, overlapping the organism, or occupying sites formed in part by the organism

prefixIRI	OGMS:0000087

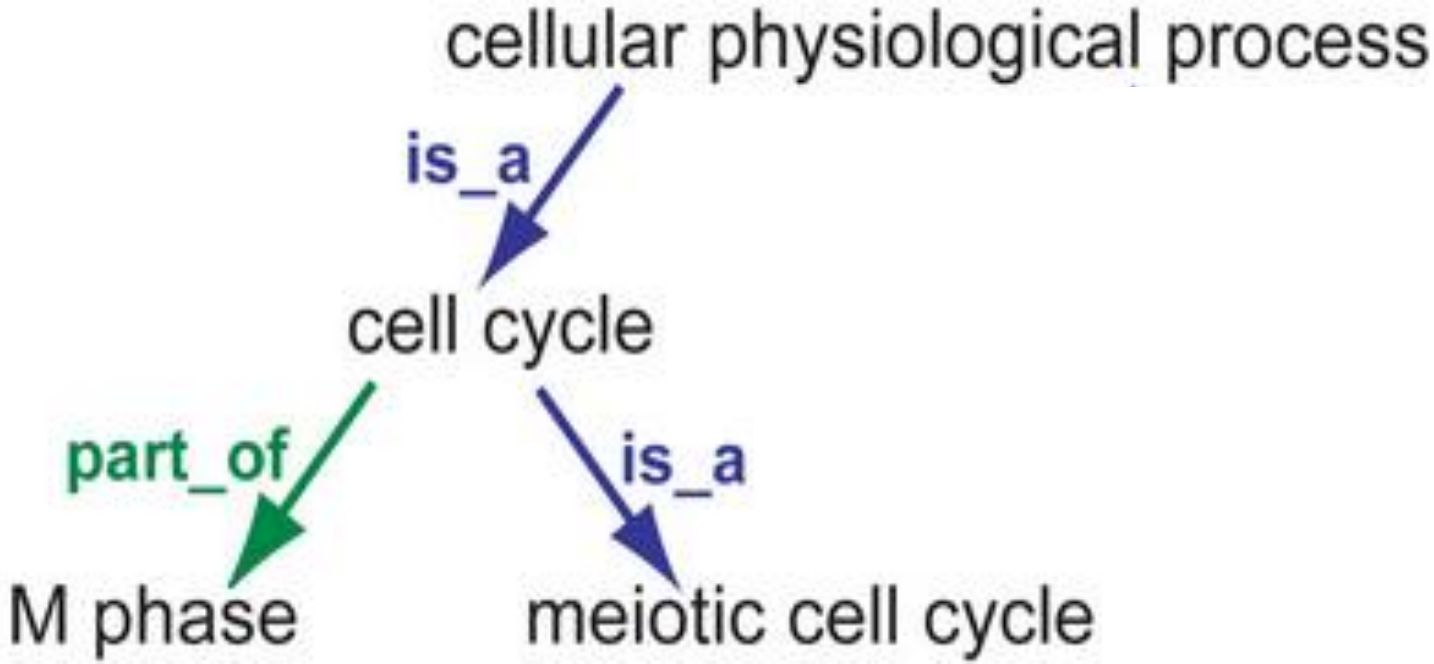
Eric Olsen

- Two different objects are equally good candidates for being the maternal organism, one having the foetus as a part and the other not.
- Call them the large mother and the small mother.
- Whether the foetus is a part of the maternal organism depends on which maternal organism we're talking about.



OBO Foundry Modular Organization

Relations


cellular physiological process
is_a
cell cycle
part_of
is_a
M phase
meiotic cell cycle

This article is part of the series Ontologies.

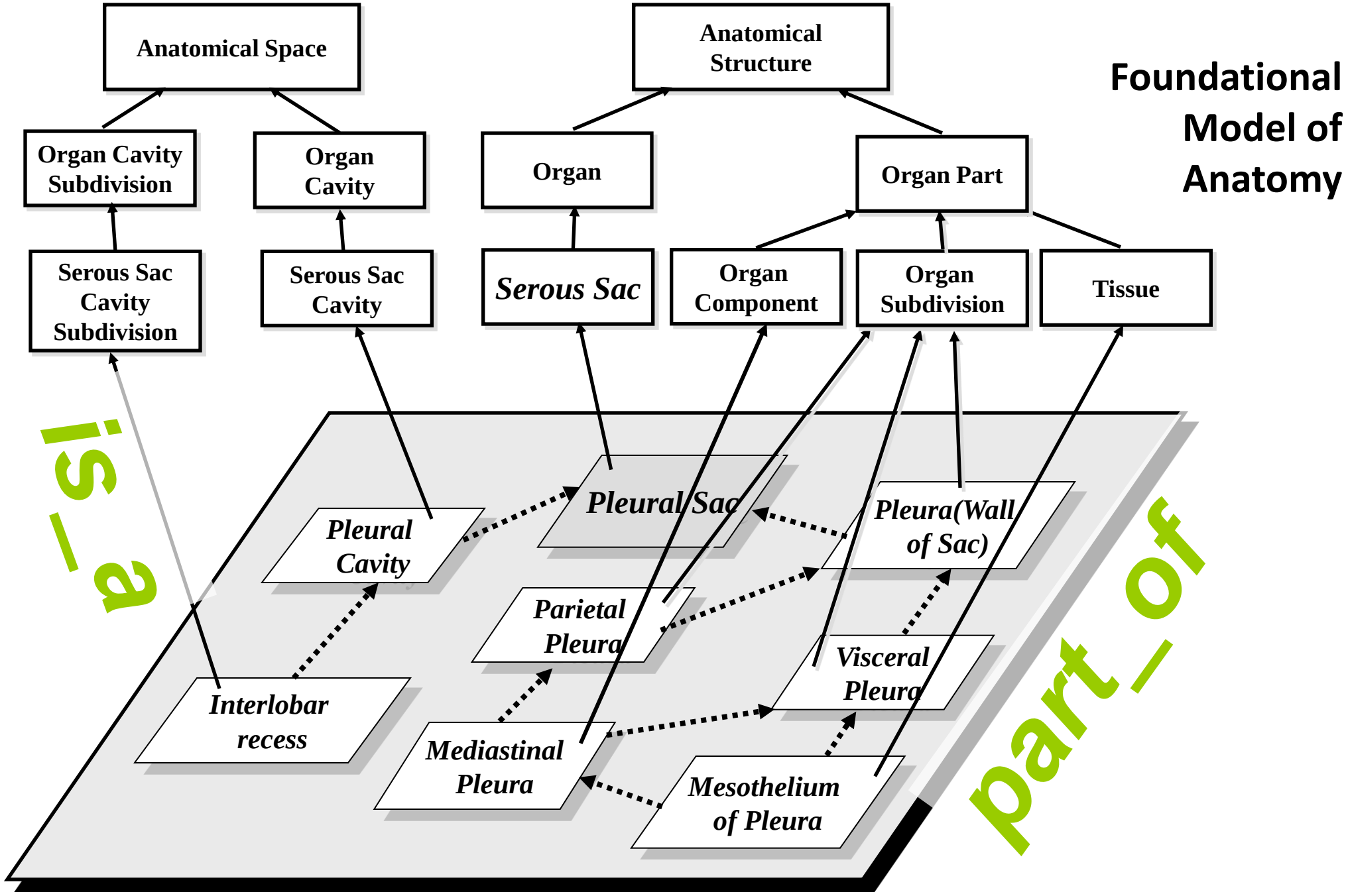
Method

Relations in biomedical ontologies

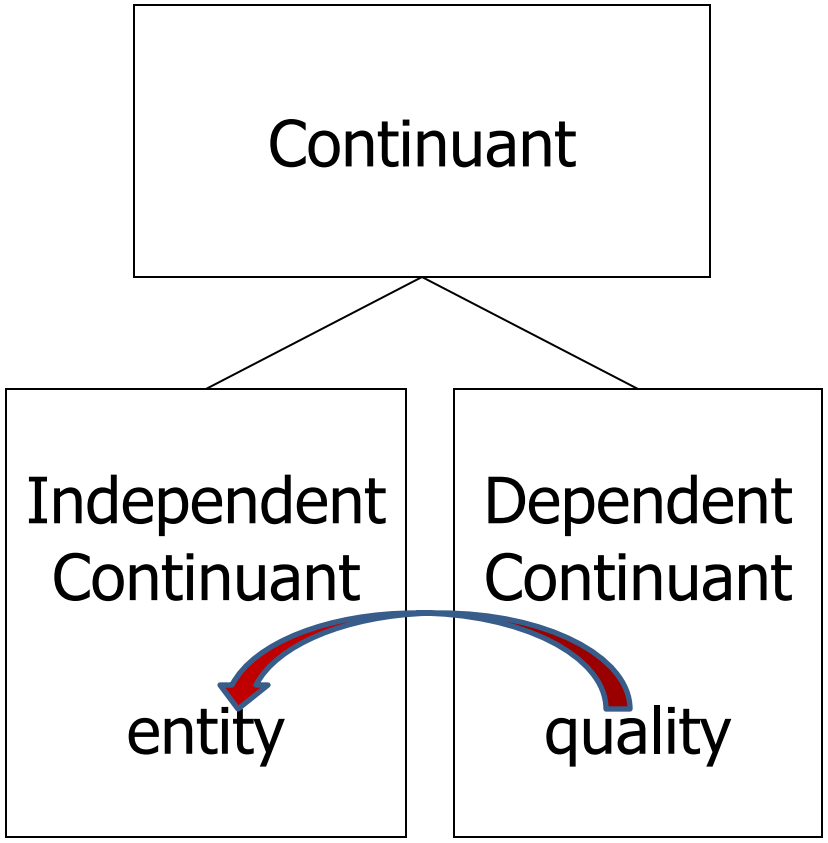
Barry Smith[1,2*], **Werner Ceusters**[3], **Bert Klagges**[4], **Jacob Köhler**[5], **Anand Kumar**[1], **Jane Lomax**[6], **Chris Mungall**[7], **Fabian Neuhaus**[1], **Alan L Rector**[8] and **Cornelius Rosse**[9]

* Corresponding author: Barry Smith phismith@buffalo.edu

Author Affiliations


Foundational Model of Anatomy
Anatomical Space
Anatomical Structure
Organ Cavity Subdivision
Organ Cavity
Organ
Organ Part
Serous Sac Cavity Subdivision
Serous Sac Cavity
Serous Sac
Organ Component
Organ Subdivision
Tissue
is_a
part_of
Pleural Sac
Pleural Cavity
Pleura(Wall of Sac)
Parietal Pleura
Visceral Pleura
Interlobar recess
Mediastinal Pleura
Mesothelium of Pleura

depends_on

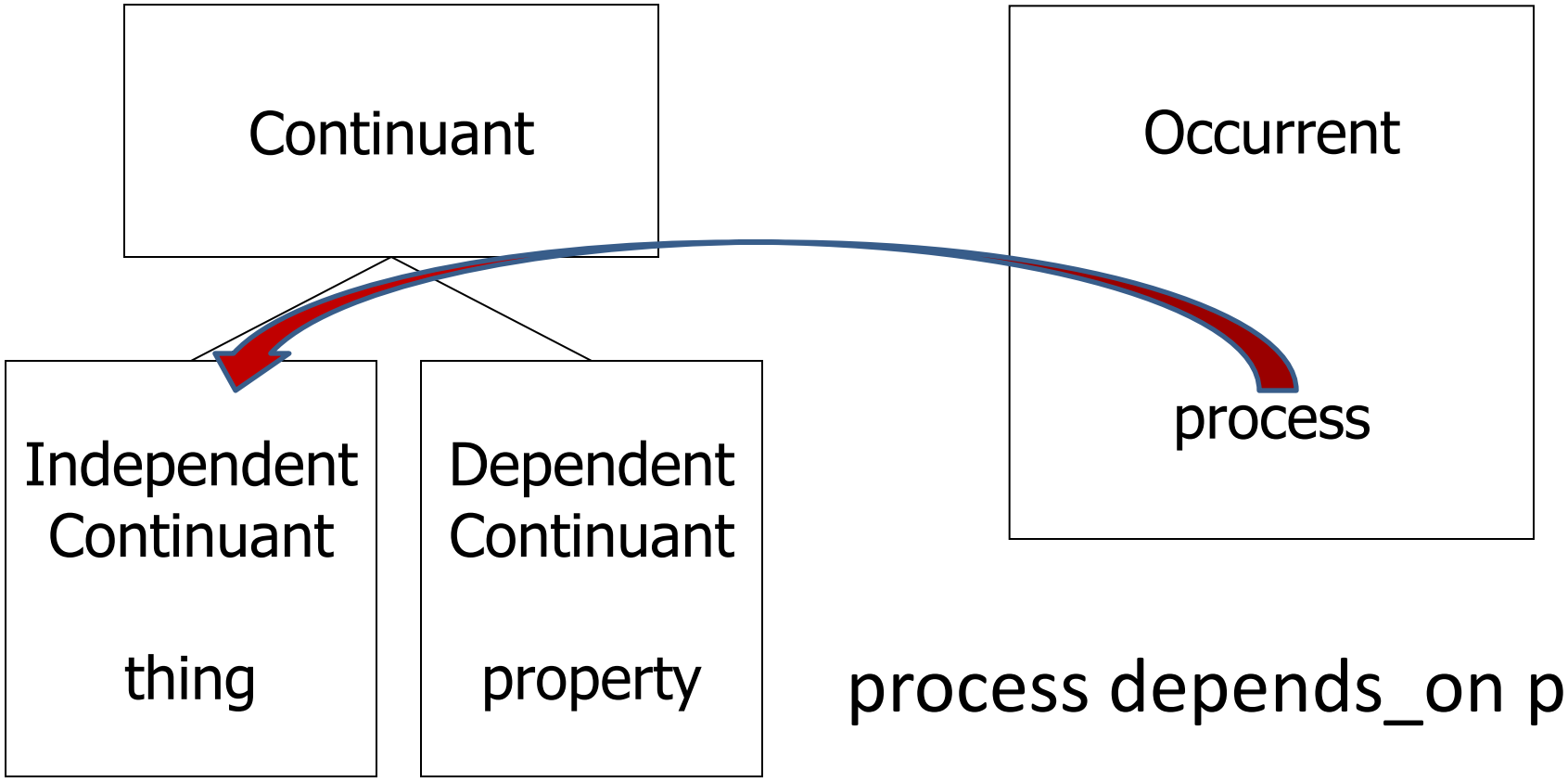


Occurrent

process, event

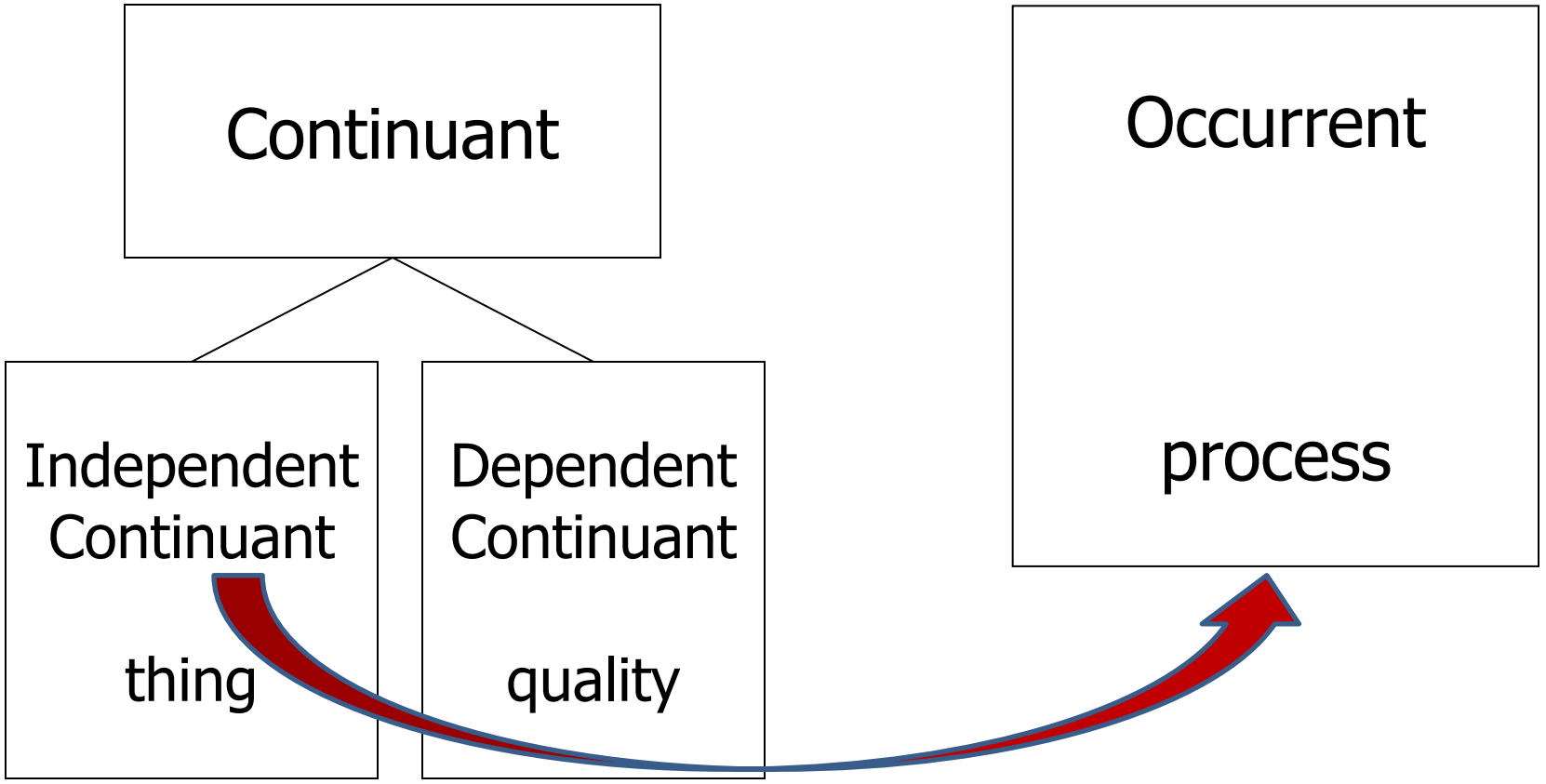
quality depends_on bearer

depends_on



process depends_on participant

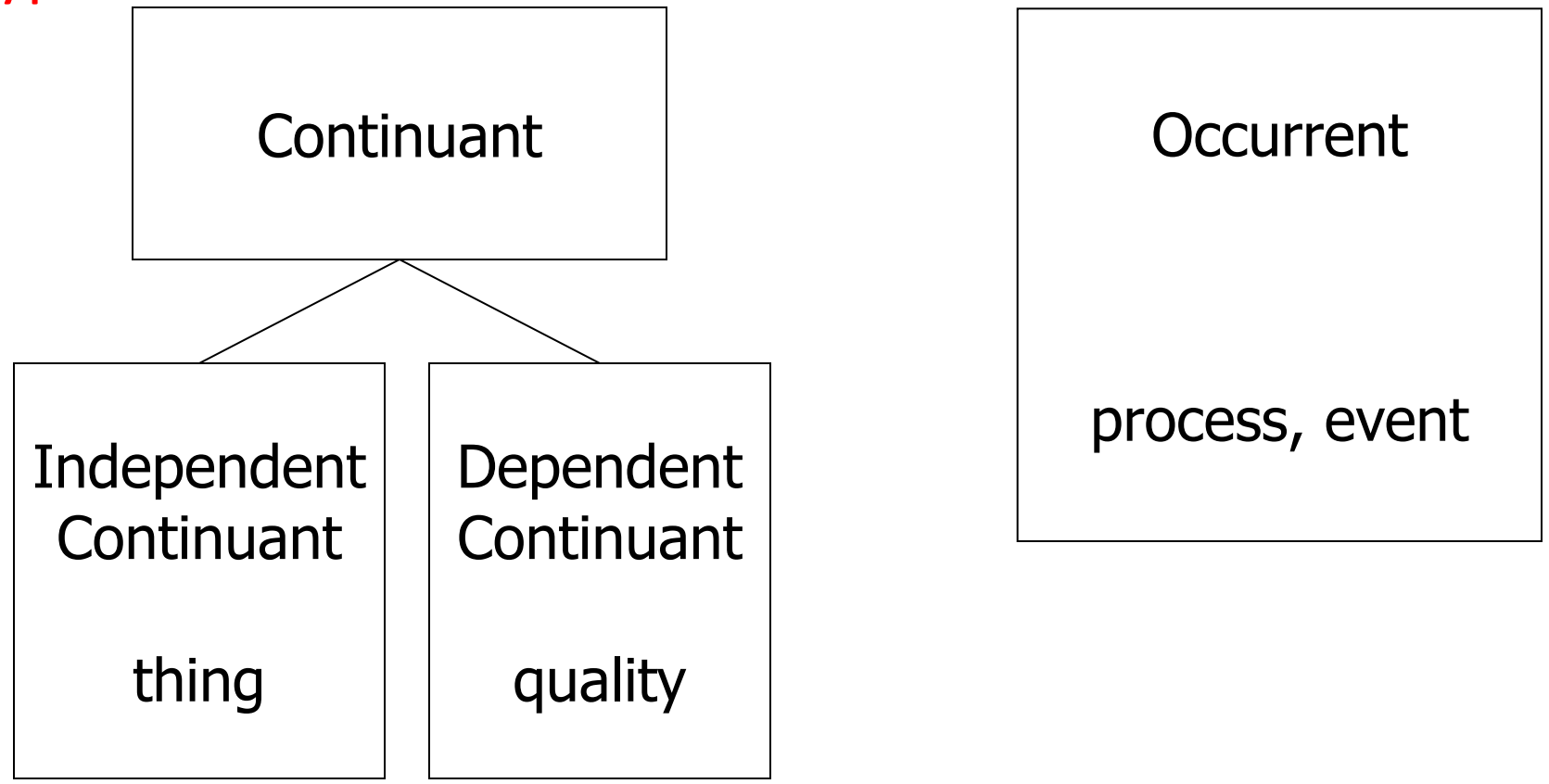
participates_in



thing participates_in process

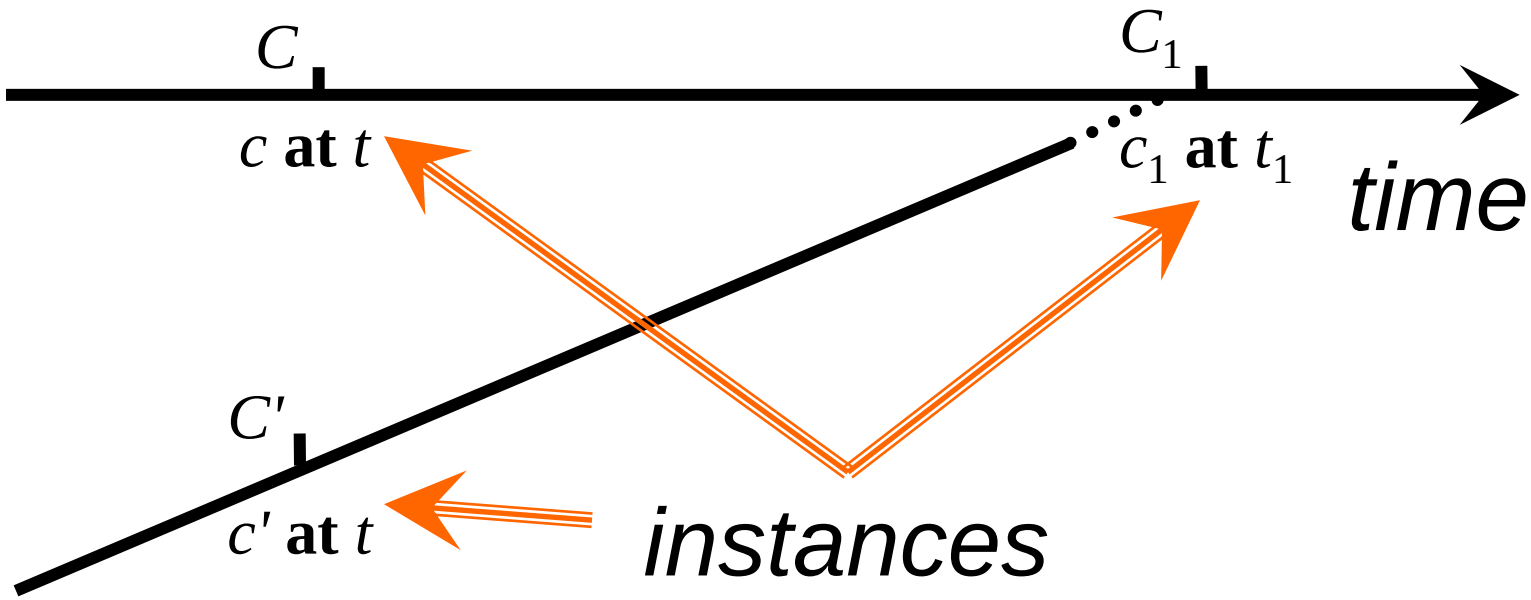
instance_of

types



instances

derives_from



zygote derives_from ovum
zygote derives_from sperm

transformation_of

pre-RNA → mature RNA

child → adult

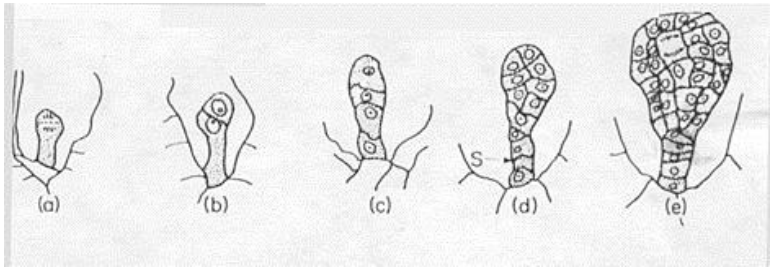
living human being → corpse

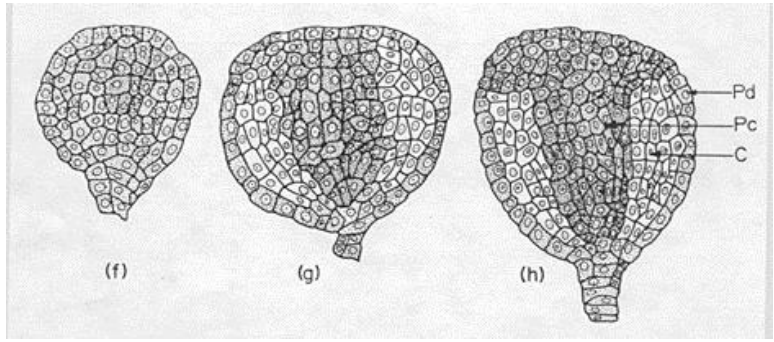
transformation_of

C_2 *transformation_of* C_1

=def. any instance of C_2 was at some earlier time an instance of C_1

transformation_of





When does the human being begin to exist?

human being =

human individual =

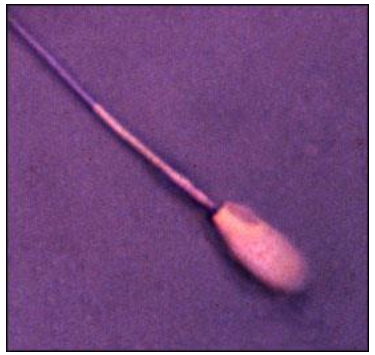
human organism

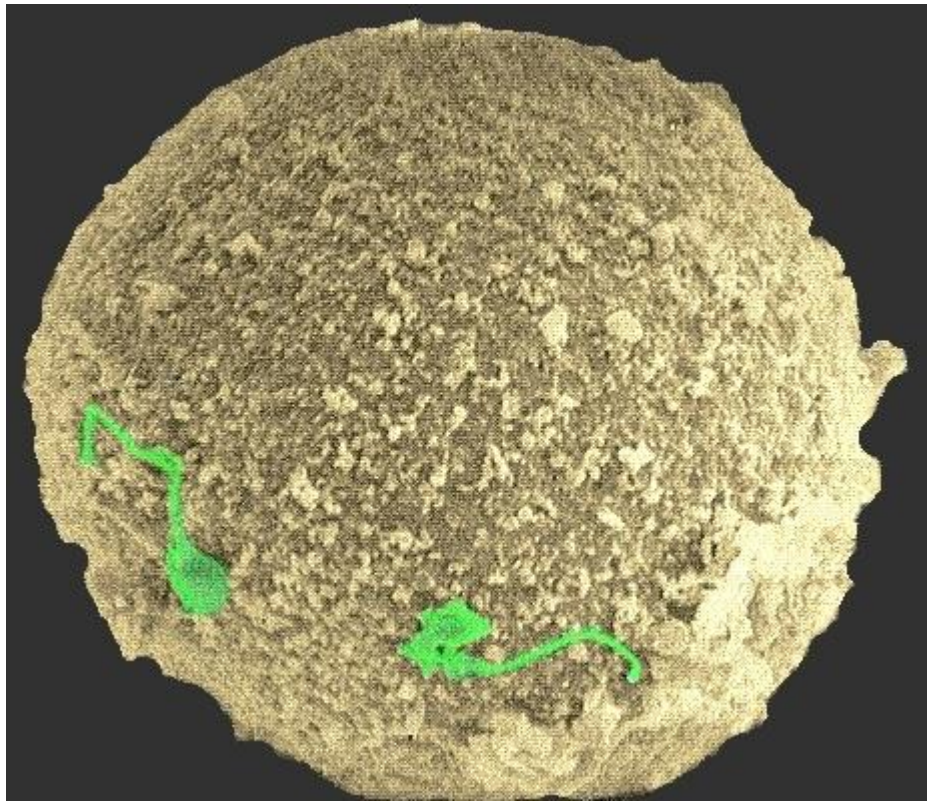
Journal of Medicine and Philosophy
2003, Vol. 28, No. 1, pp. 45–78

Sixteen Days

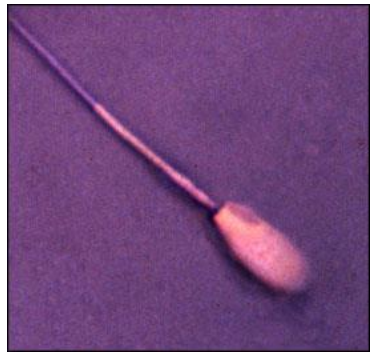
Barry Smith[1] and Berit Brogaard[2]
[1]Institute for Formal Ontology and Medical Information Science,
University of Leipzig, Leipzig, Germany, and [2]Department of Phil
Southern Illinois University, Edwardsville, IL, USA

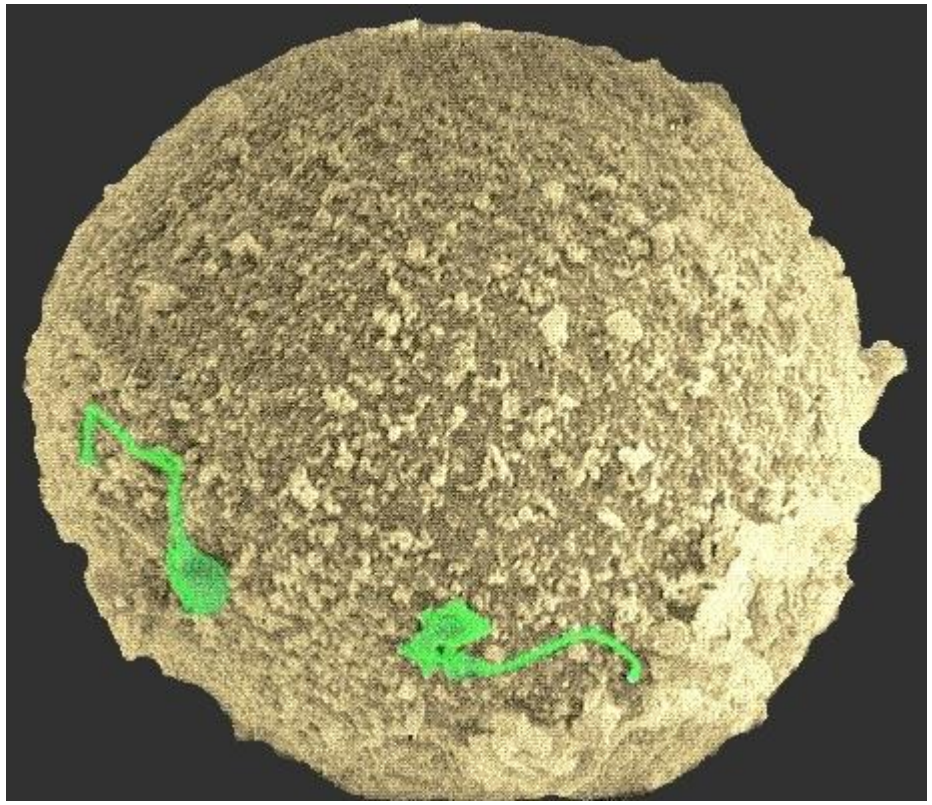
first there are two:



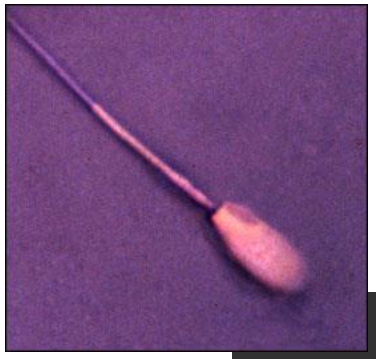


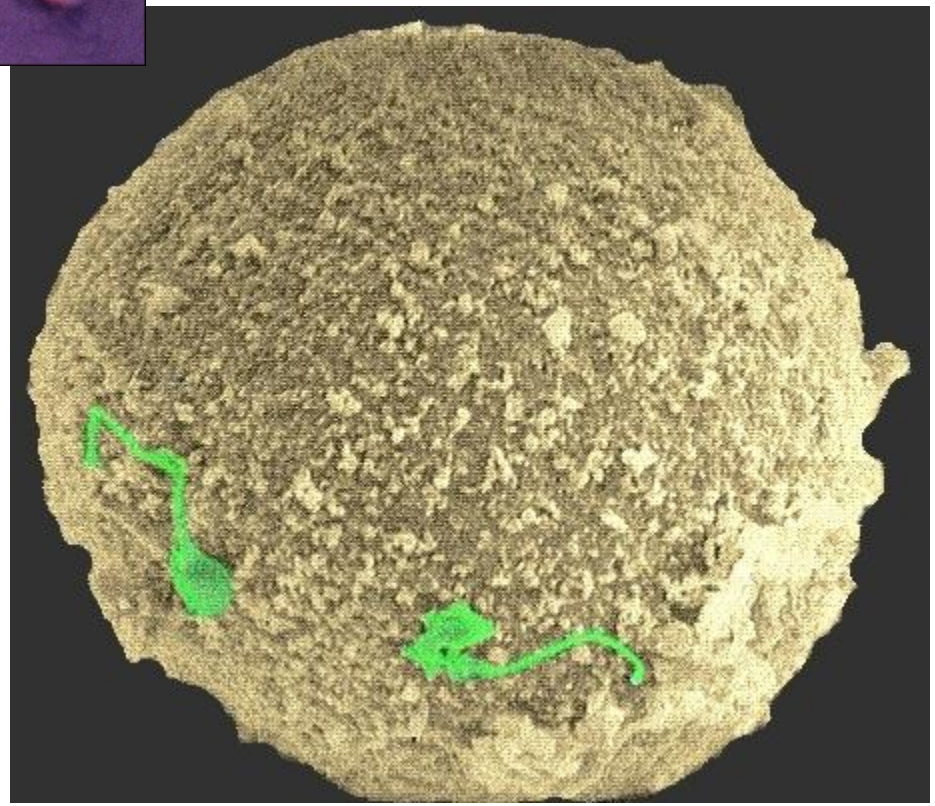
first there are two:

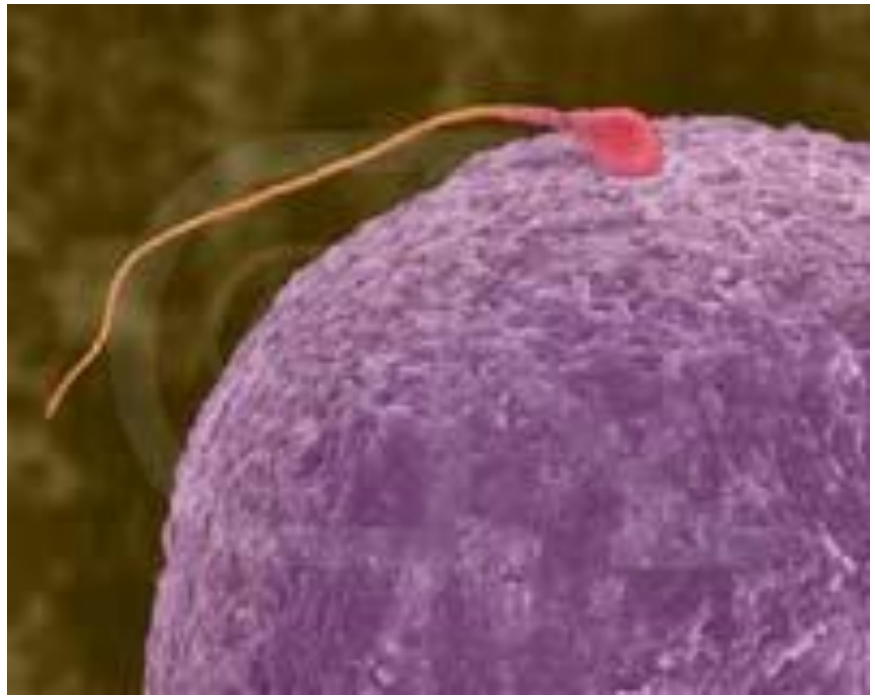




first there are two:







and then there is one

time goes on

when did this human individual begin to exist?

Substantial change

two drops of water flow together and become one

two early embryos fuse to become one

an ameoba splits and becomes two

a block of marble is spit and becomes two

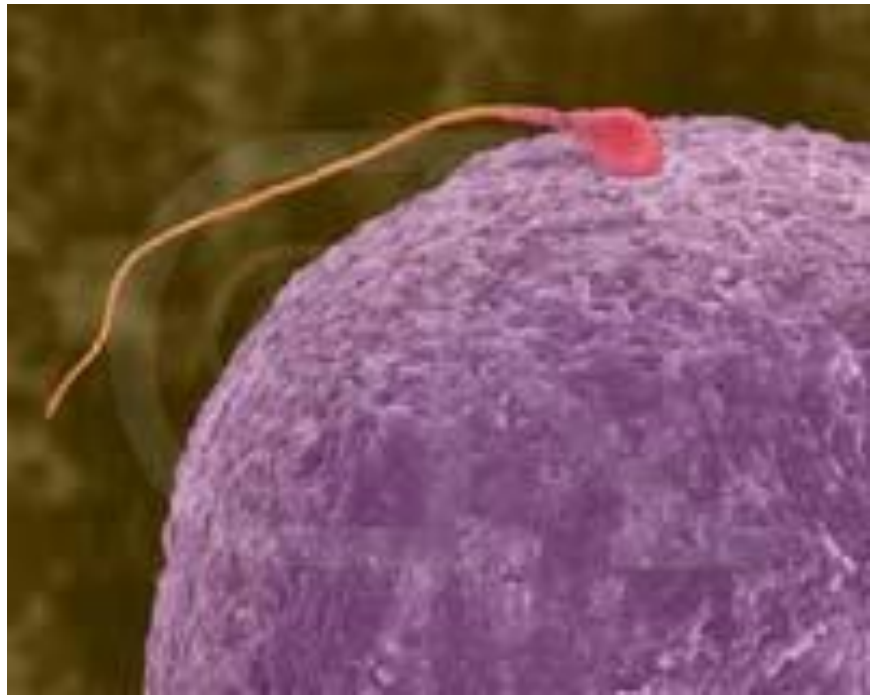
a pair of conjoined twins is separated and becomes two

when did this human individual begin to exist?

a. single-cell (zygote) (day 0)
b: multi-cell (days 0-3)
c. morula (day 3)
d. early blastocyst (day 4)
e. implantation (days 6-13)
f. gastrulation (days 14-16)
g. neurulation (from day 16)
h. formation of the brain stem (days 40-43)
i. end of first trimester (day 98)
j. viability (around day 130)
k. sentience (around day 140)
l. quickening (around day 150)
m. birth (day 266)
n. the development of self-consciousness (some time after birth) – human *person*

One attractive threshold for substantial change

formation of zygote
(fertilization)



a. single-cell (zygote) (day 0)

b: multi-cell (days 0-3)

c. morula (day 3)

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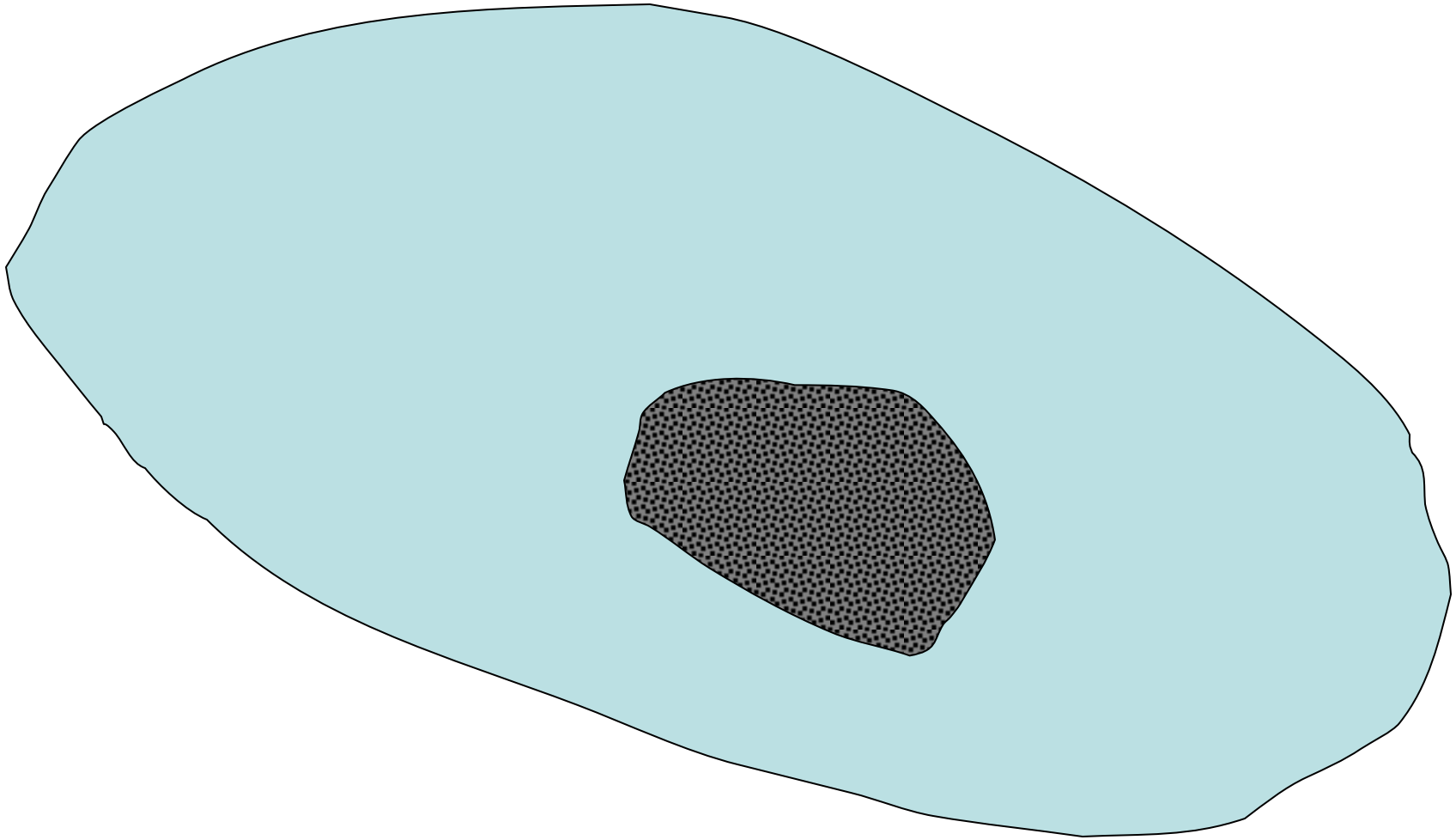
n. the development of self-consciousness (some time after birth) – human *person*

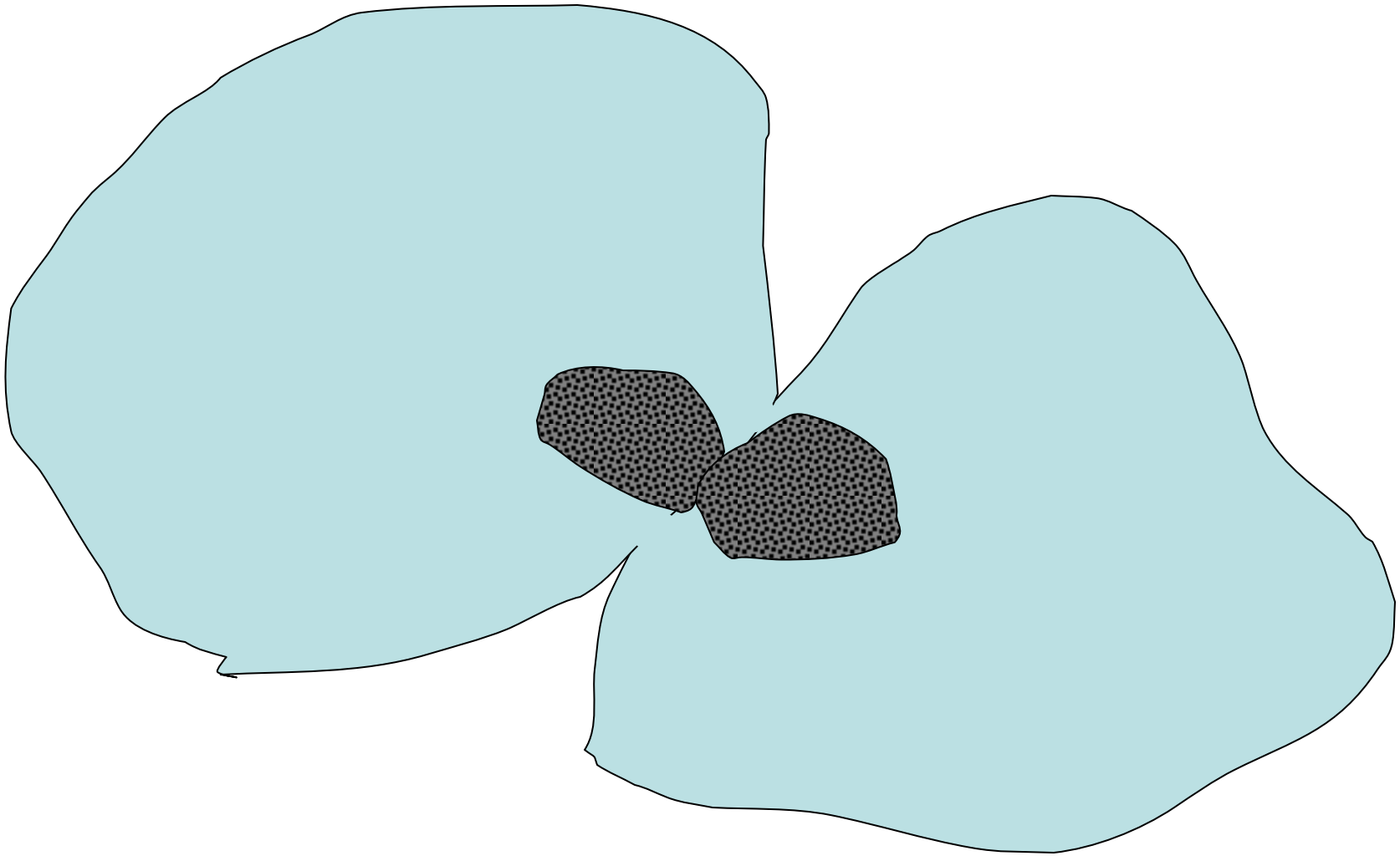
zygote = human individual?



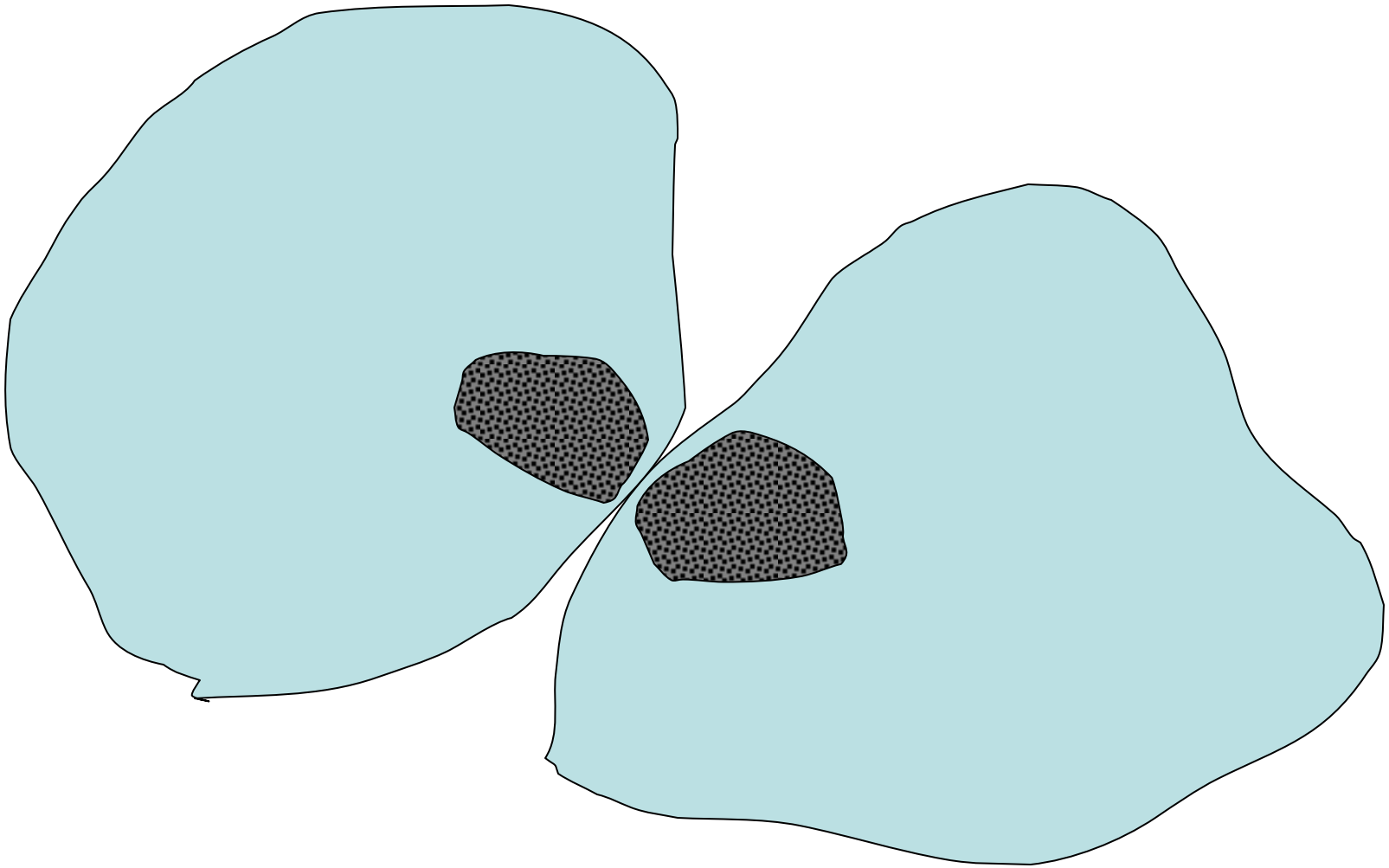
perhaps yes

but the *same* human individual as this?

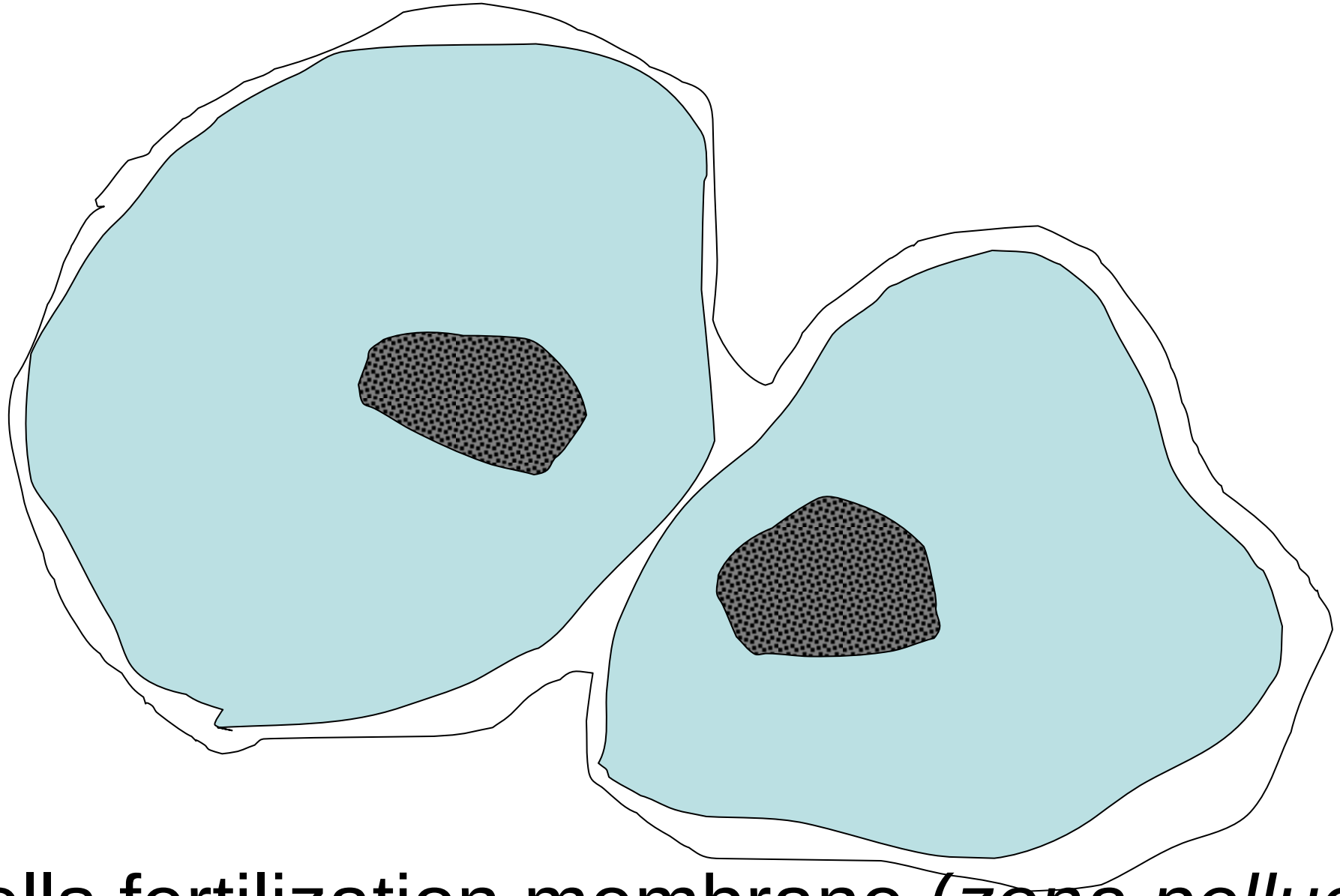
because almost immediately …



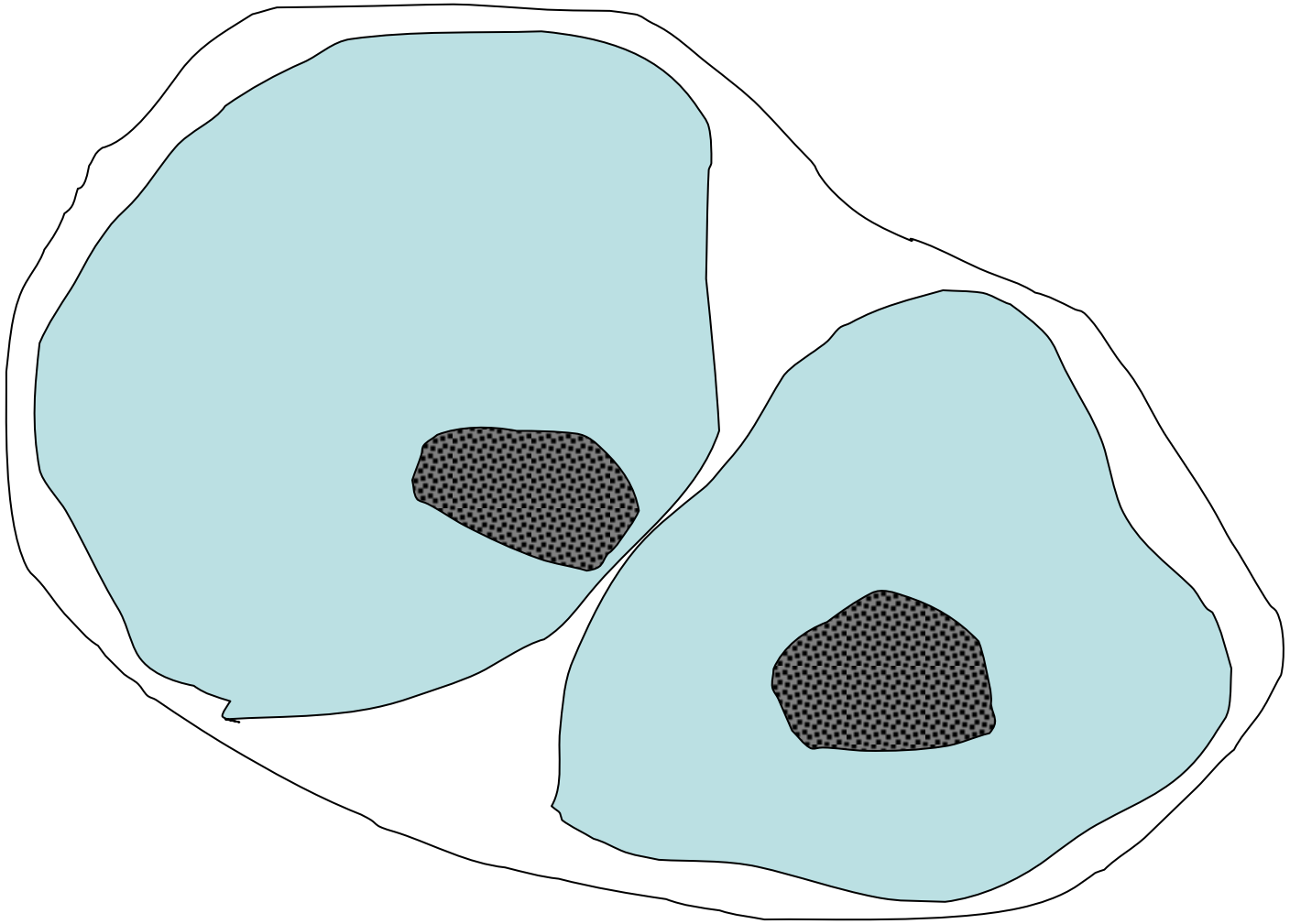
… cleavage



which one is the human individual?



2 cells fertilization membrane (*zona pellucida*)



this whole, bound by *zona pellucida* = human individual –
a view of this sort is defended by Rose Hershenov (see:
http://www.metaphysicsandbioethics.com/)

and so on

on this view, we were all once zygotes, we were all once blastulas, …

a. single-cell (zygote) (day 0)
b: multi-cell (days 0-3)
c. morula (day 3)
d. early blastocyst (day 4)
e. implantation (days 6-13)
f. gastrulation (days 14-16)
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n. the development of self-consciousness (some time after birth) – human *person*

Days 14-16: Gastrulation

Gastrulation transforms the blastula from a cluster of cells into a single heterogeneous entity—a whole multicellular individual living being which has a body axis and bilateral symmetry and its own mechanisms to protect itself and to restore stability in face of disturbance.

Wolpert

“It is not birth, marriage or death, but gastrulation, which is truly the most important event in your life.”

Neurulation (begins day 16)

transforms the gastrula by establishing the beginning of the central nervous system.

A 2nd massive migration of cells and topological folding and connecting and subsequent cell specialization yielding neural tube

a. single-cell (zygote) (day 0)
b: multi-cell (days 0-3)
c. morula (day 3)
d. early blastocyst (day 4)
e. implantation (days 6-13)
f. gastrulation (days 14-16)

g. neurulation (from day 16)
h. formation of the brain stem (days 40-43)
i. end of first trimester (day 98)
j. viability (around day 130)
k. sentience (around day 140)
l. quickening (around day 150)
m. birth (day 266)
n. the development of self-consciousness (some time after birth) – human *person*

Conclusion of “16 Days”

a substantial change occurs *at the latest* 16 days after fertilization

and as a result of this substantial change a human being* comes into existence

*you

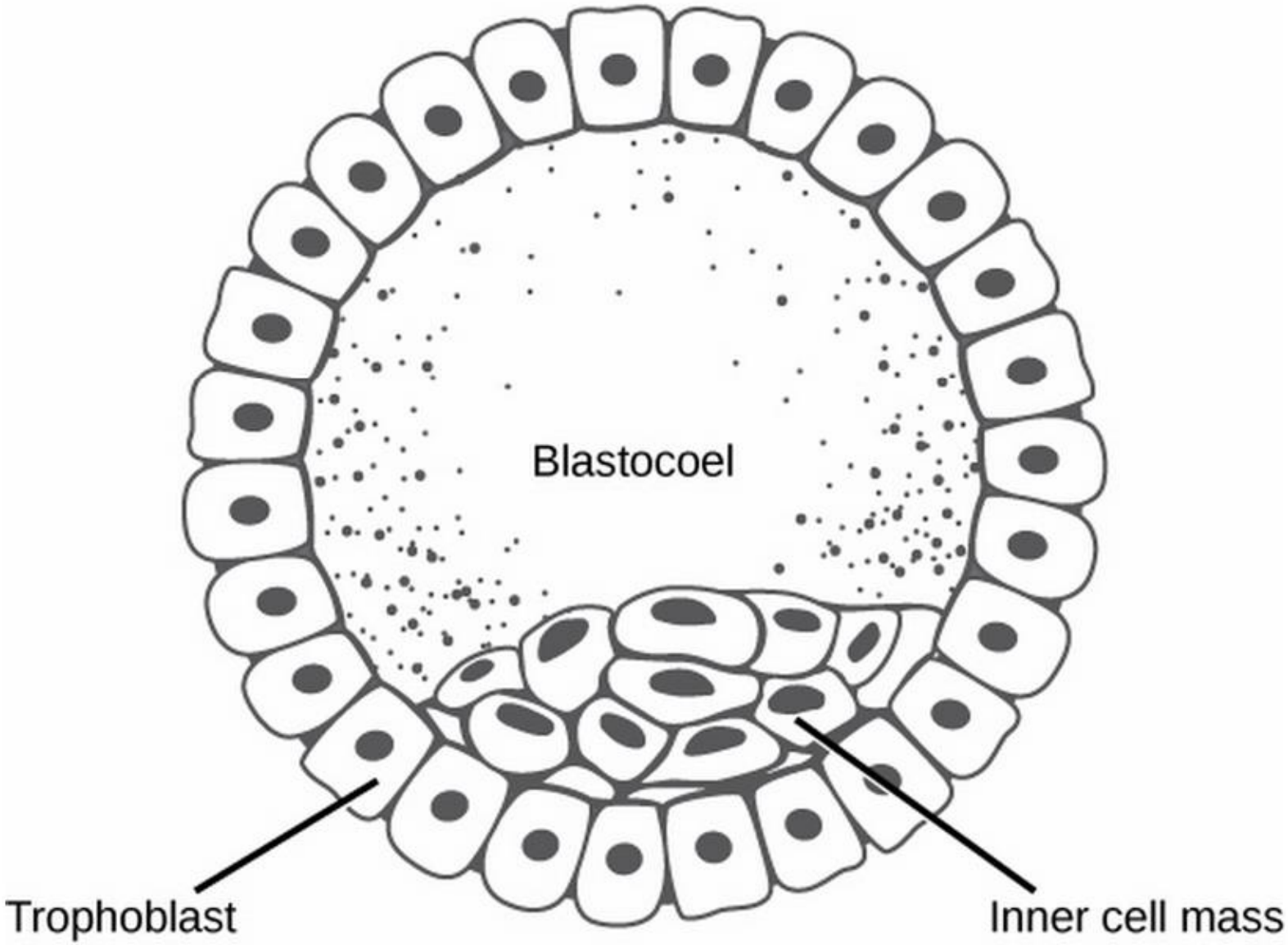
One question: was I ever a whole blastula?

Another question: was I ever a part of my mother?

Is the blastula like gut flora, or gut pathogens?

Or is it like the kidney or the liver, an organ of the mother?

Blastula



hatching of the blastocyst from out of the fertilization membrane and adhesion on the endometrium

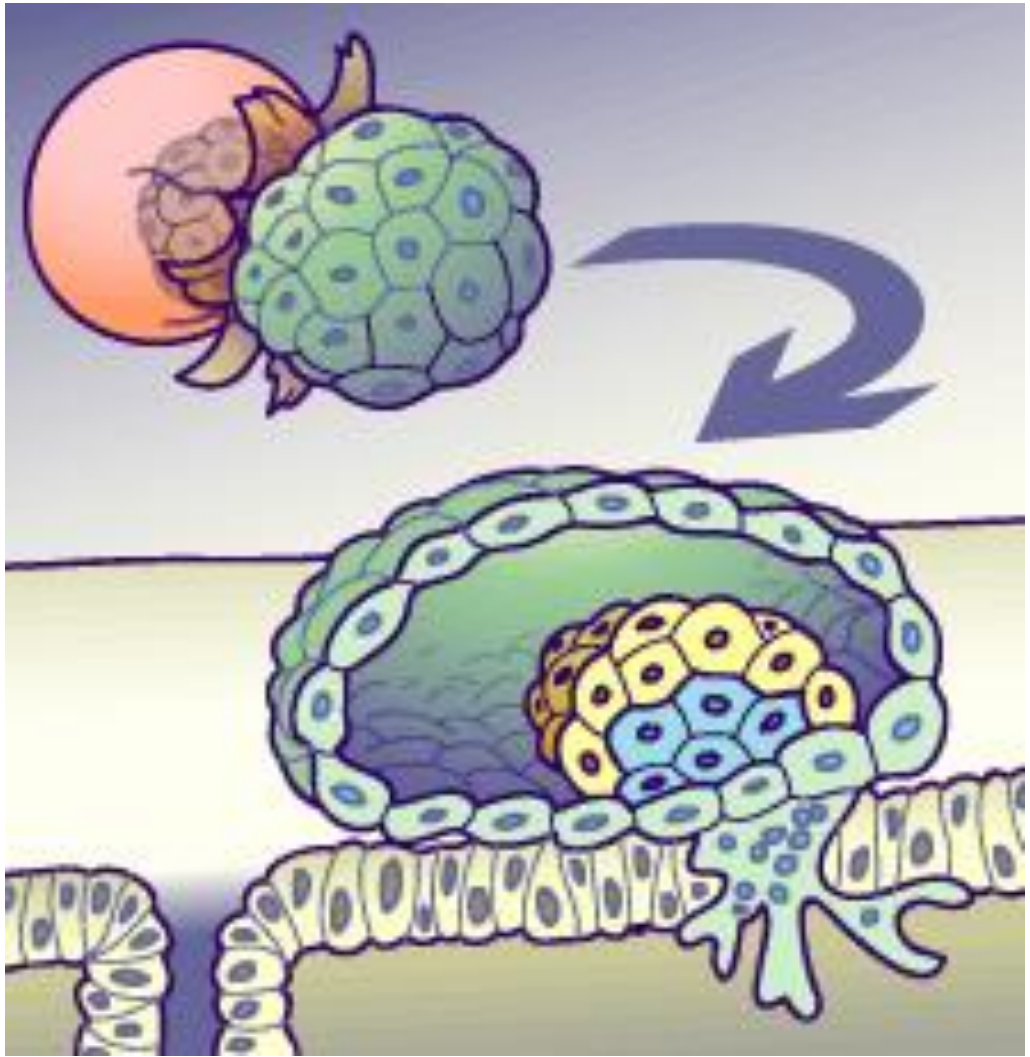
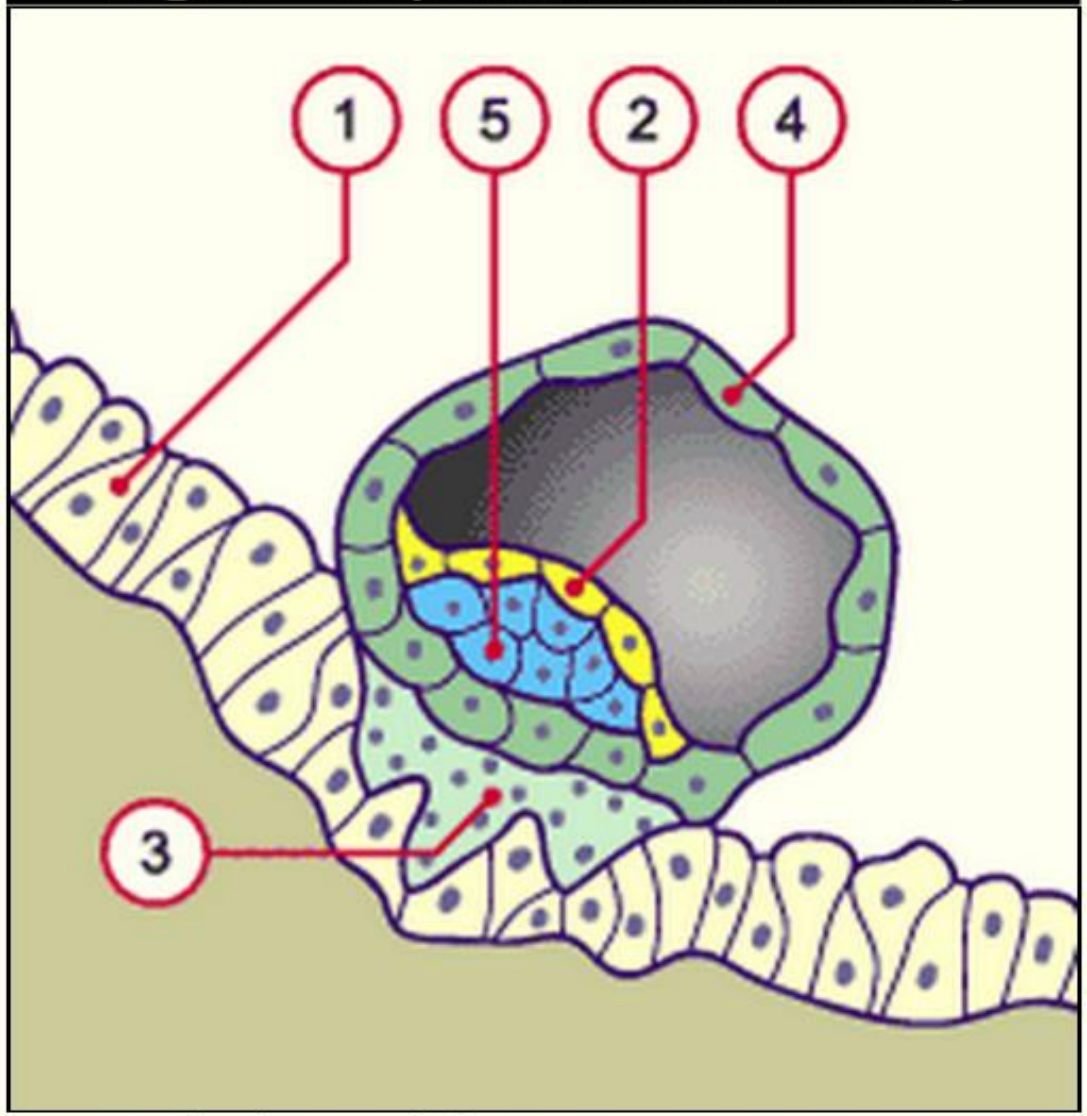
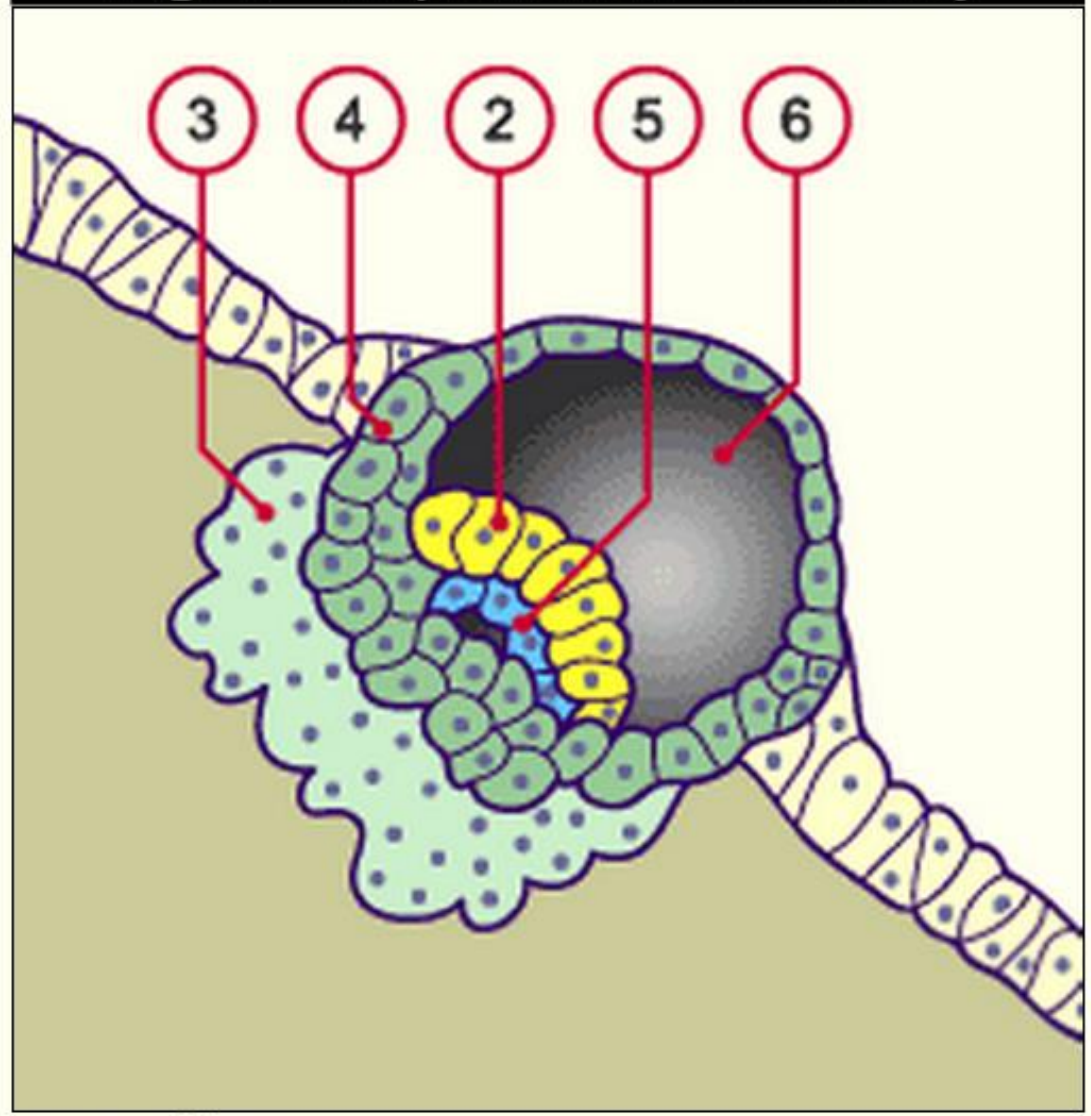


Fig. 18 - Implantation: 6th-7th day



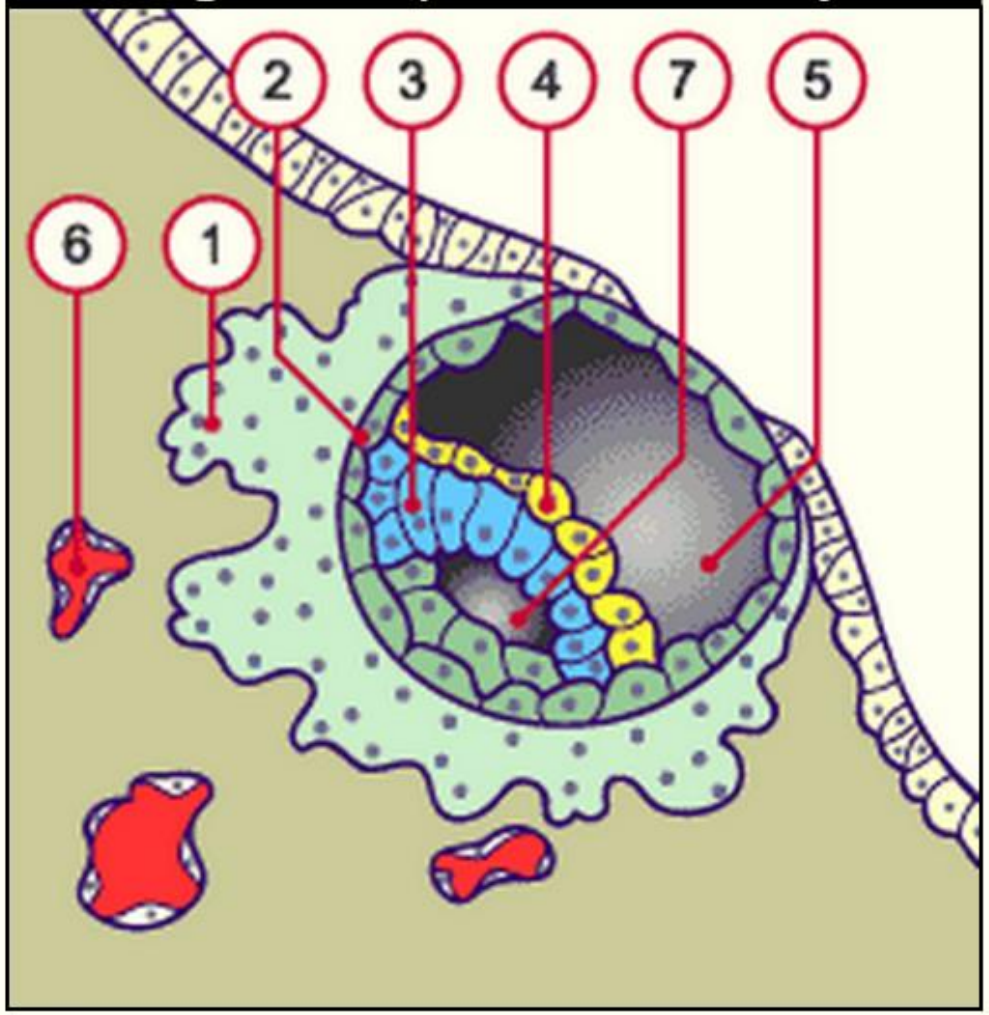
1 Epithelium of the uterine mucosa
2 Hypoblast
3 Syncytiotrophoblast
4 Cytotrophoblast

Fig. 19 - Implantation: 7th-8th day



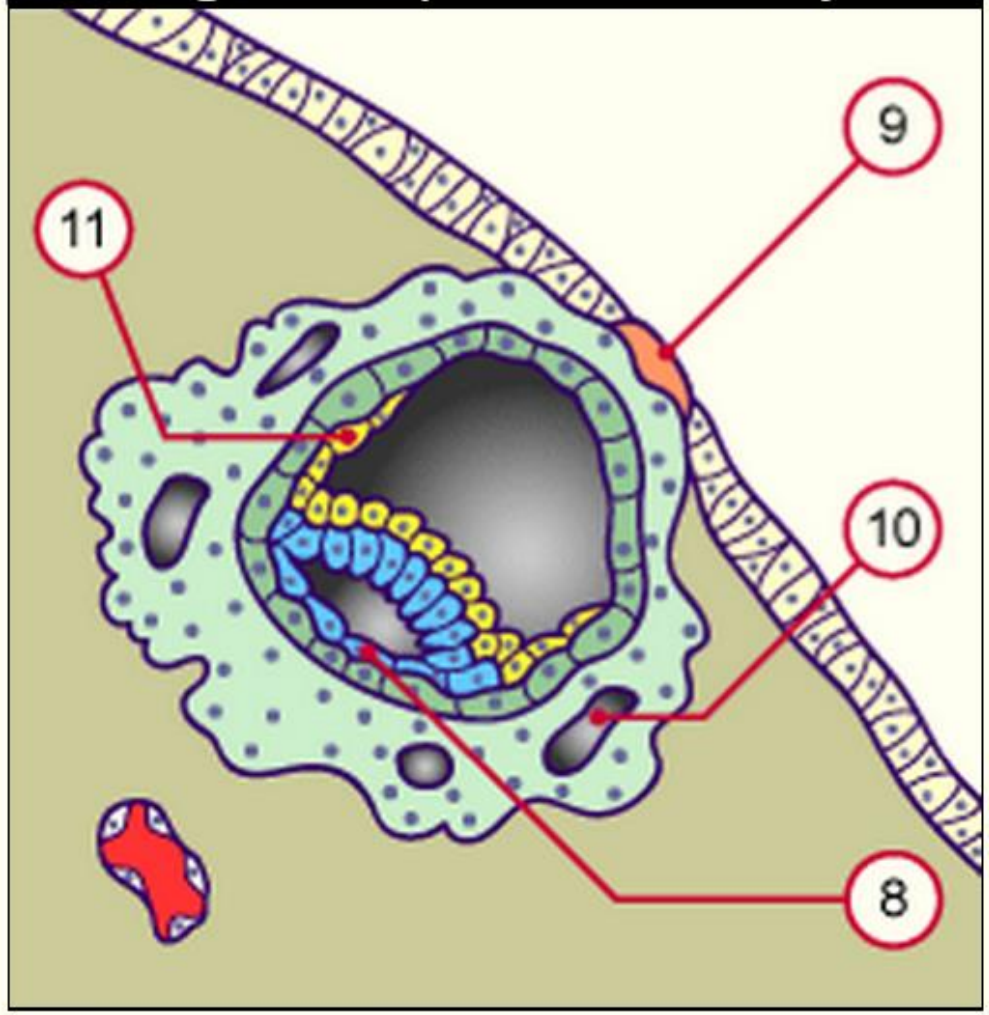
5 Epiblast
6 Blastocyst cavity

Fig. 20 - Implantation: 8th day



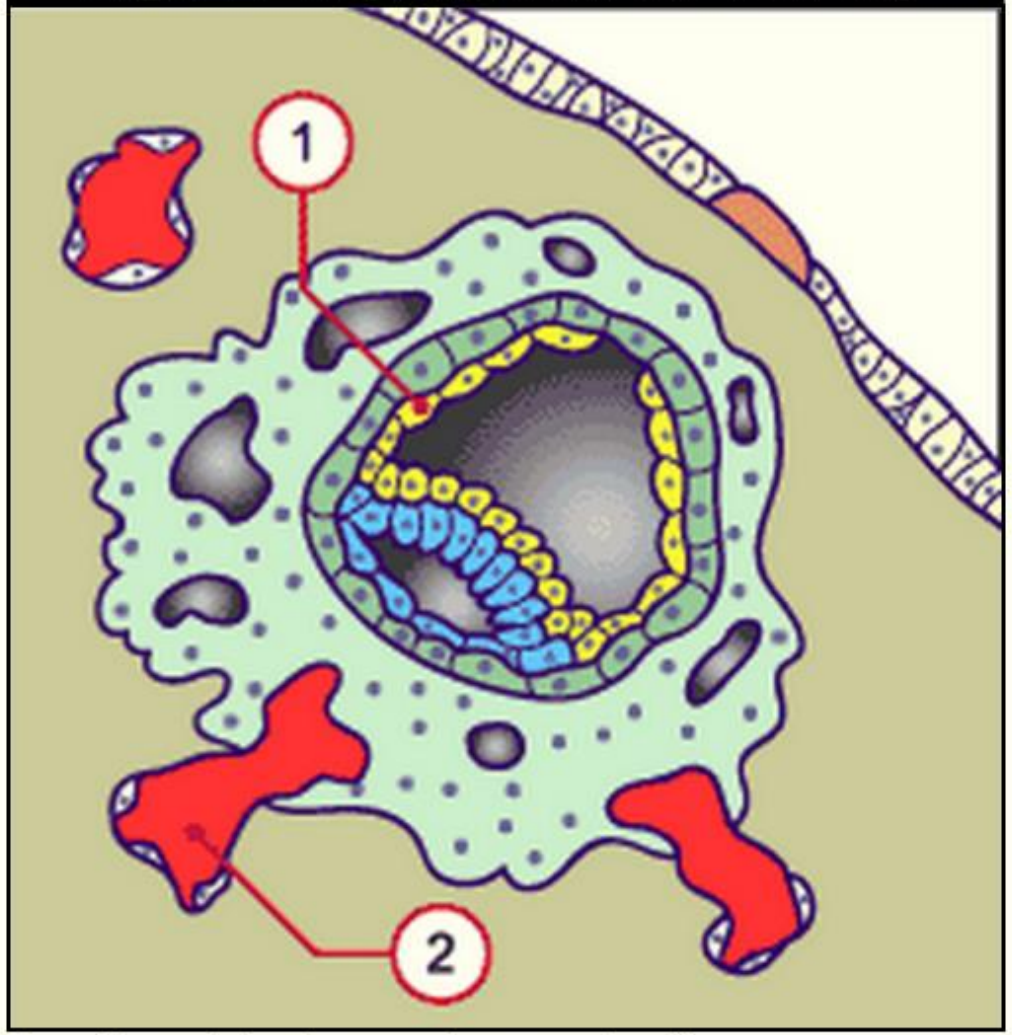
1 Syncytiotrophoblast (ST)
2 Cytotrophoblast (CT)
3 Epiblast
4 Hypoblast
5 Blastocyst cavity
6 Maternal blood capillary
7 Amniotic cavity

Fig. 21 - Implantation: 9th day



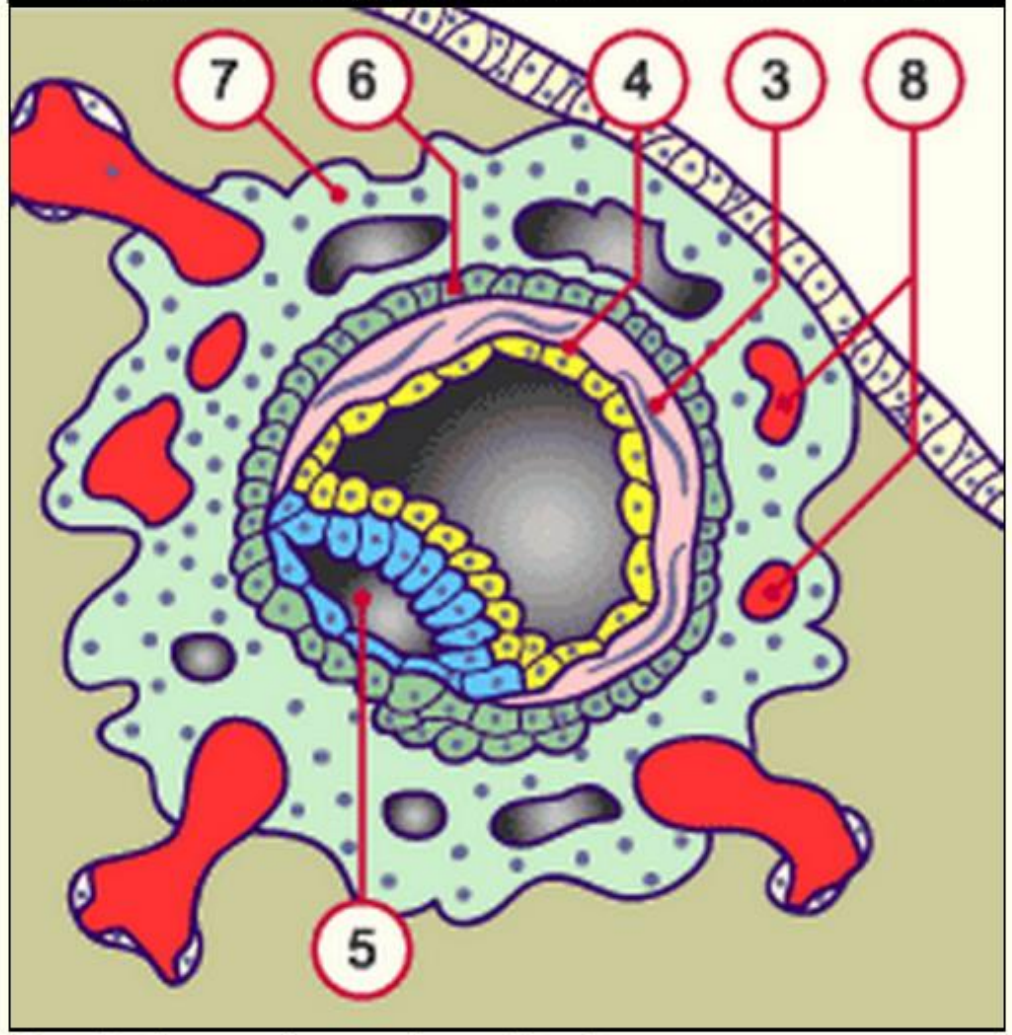
8 Amnioblasts
9 Fibrin plug
10 Trophoblast lacunae
11 Multiplying hypoblast

Fig. 22 - Implantation: 9th-10th day



1 Hypoblast growing ventrally
2 Eroded maternal capillaries

Fig. 23 - Implantation: 10th-11th day



3 Extraembryonic reticulum
4 Heuser´s membrane
5 Amniotic cavity
6 Cytotrophoblast
7 Syncytiotrophoblast
8 Lacunae, filled with blood

AMIA Annu Symp Proc. 2005; 2005: 669–673. PMCID: PMC1560856

How to Distinguish Parthood from Location in Bio-Ontologies

Stefan Schulz,[a,b] Philipp Daumke,[a] Barry Smith,[c,d] and Udo Hahn[e]

Author information ► Copyright and License information ►

Is something in the extended organism a part_of the organism or just contained_in

Is it an Artifact – Yes → then contained_in

No. Is it necessary for the organism's functioning?

Yes → Then part_of

No. Does it have the same genetic origin?

Yes → Then part_of

No → Then contained_in

NOTE THE ABOVE (WHICH DATES FROM 2005) NEEDS RADICAL IMPROVEMENT

Examples

Amalgam filling in a tooth: Contained_in (Artifact)

A transplanted lung in an organism: Part_of

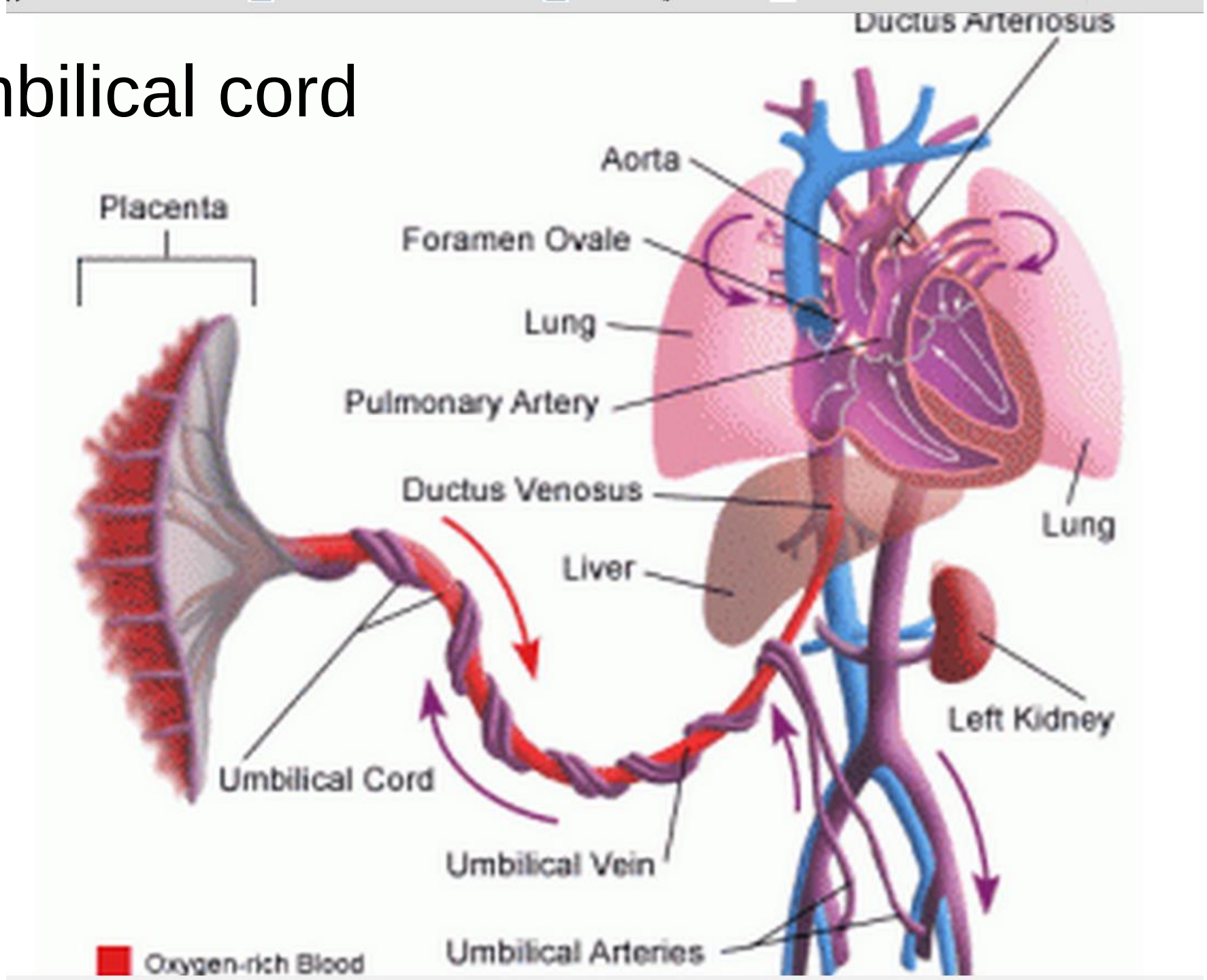
A metastasis of a breast cancer in the brain: Contained_in

A bacterium inside your gut: Contained_in

A glioblastoma in the brain: Part_of. The tumor is not functionally related to the brain, but it has its origin therein.

A fetus in the womb of a mother. No – because not necessary for functioning.

Umbilical cord



Metaphysics of Pregnancy

Foetuses as part of the maternal organism

Elselijn Kingma

e.m.kingma@soton.ac.uk

Background *Metaphysics of Pregnancy*

Three Questions:

- What is the relationship between pregnant organism and foetus?
- When does one organism become two?
- What entities (if any) persist through pregnancy and birth

What is the relationship between Gravida and Foster?

Part-whole model: Foster is part of the Gravida as much as her organs and other bits are.

Background/Caveats

- Forget about Persons!!!!!!!
- Placental Mammals only

…

On Elselijn's view

- Foster before implantation is not part of the mother
- Foster at implantation *becomes* an organ of the mother
- Foster at birth *becomes* a *new organism* just in virtue of walking out the door

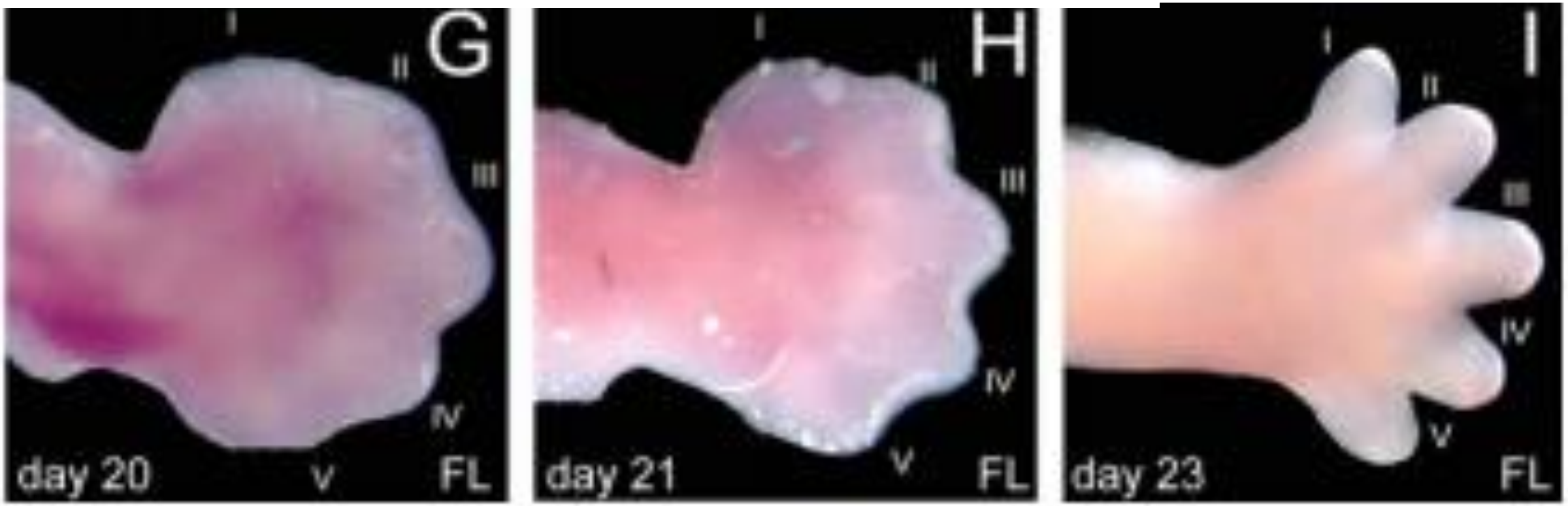
Wallabies give birth to very immature young that complete most of their development attached to the teat, usually within a pouch


BBC

Developmental Dynamics
Volume 243, Issue 2, Article first published online: 13 NOV 2013

Heterochrony in the Regulation of the Developing Marsupial Limb

Keng Yih Chew,[1] Geoffrey Shaw,[1,2] Hongshi Yu,[1,2] Andrew J. Pask,[1,2] and Marilyn B. Renfree[1,2]*

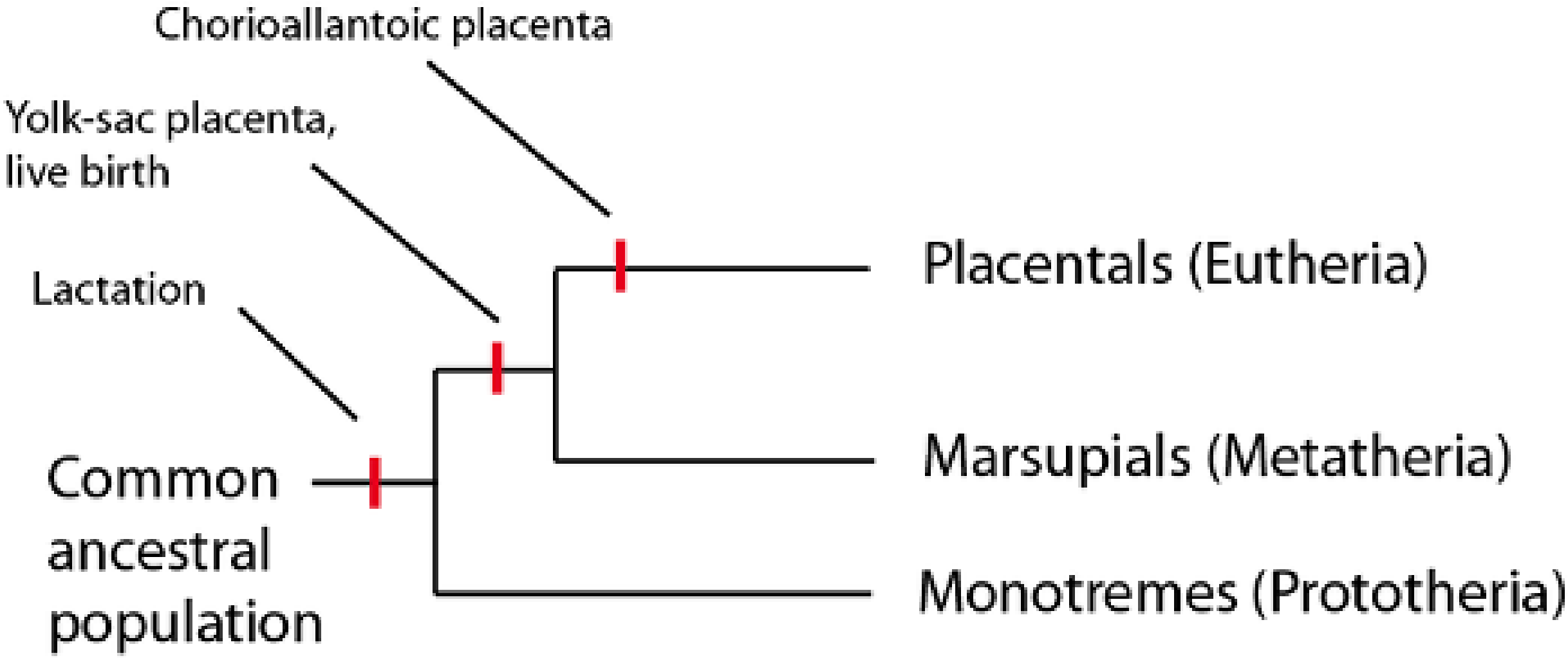


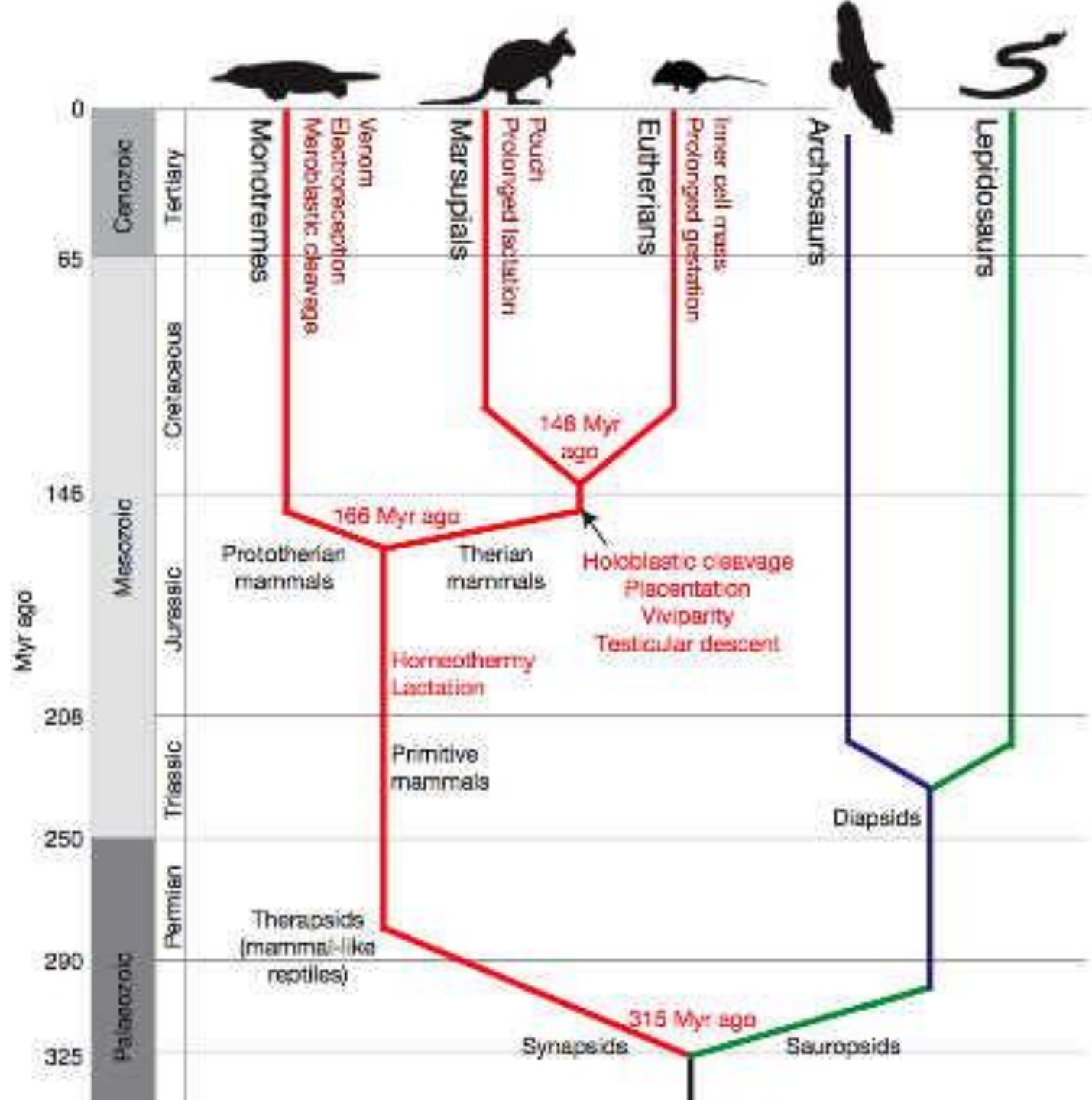
Three kinds of mammals

merotremes (give birth by laying eggs)

marsupial (joeys and pouches)

placental (placenta shared between mother and fetus)


Chorioallantoic placenta
Yolk-sac placenta, live birth
Lactation
Common ancestral population
Placentals (Eutheria)
Marsupials (Metatheria)
Monotremes (Prototheria)


Monotremes
Marsupials
Eutherians
Archosaurs
Lepidosaurs
Venom
Electroreception
Meroblastic cleavage
Pouch
Prolonged lactation
Inner cell mass
Prolonged gestation
146 Myr ago
166 Myr ago
Prototherian mammals
Therian mammals
Holoblastic cleavage
Placentation
Viviparity
Testicular descent
Homeothermy
Lactation
Primitive mammals
Diapsids
Therapsids (mammal-like reptiles)
315 Myr ago
Synapsids
Sauropsids
Myr ago
0
65
146
208
250
290
325
Cenozoic
Mesozoic
Paleozoic
Tertiary
Cretaceous
Jurassic
Triassic
Permian

most reptiles lay eggs

but in the case of some snakes and lizards, the eggs develop inside the mother's body so that she gives birth to live young

babies are born inside a thin membrane which they wrip apart with their teeth

ECOLOGY LETTERS

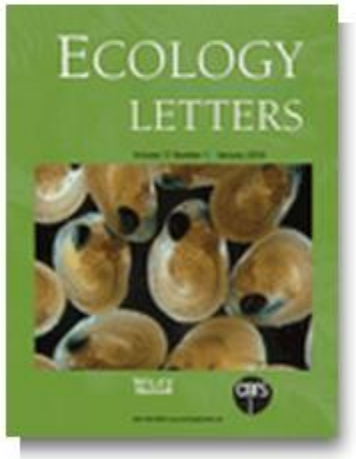
Letter

Early origin of viviparity and multiple reversions to oviparity in squamate reptiles

R. Alexander Pyron[1,*] and Frank T. Burbrink[2,3]

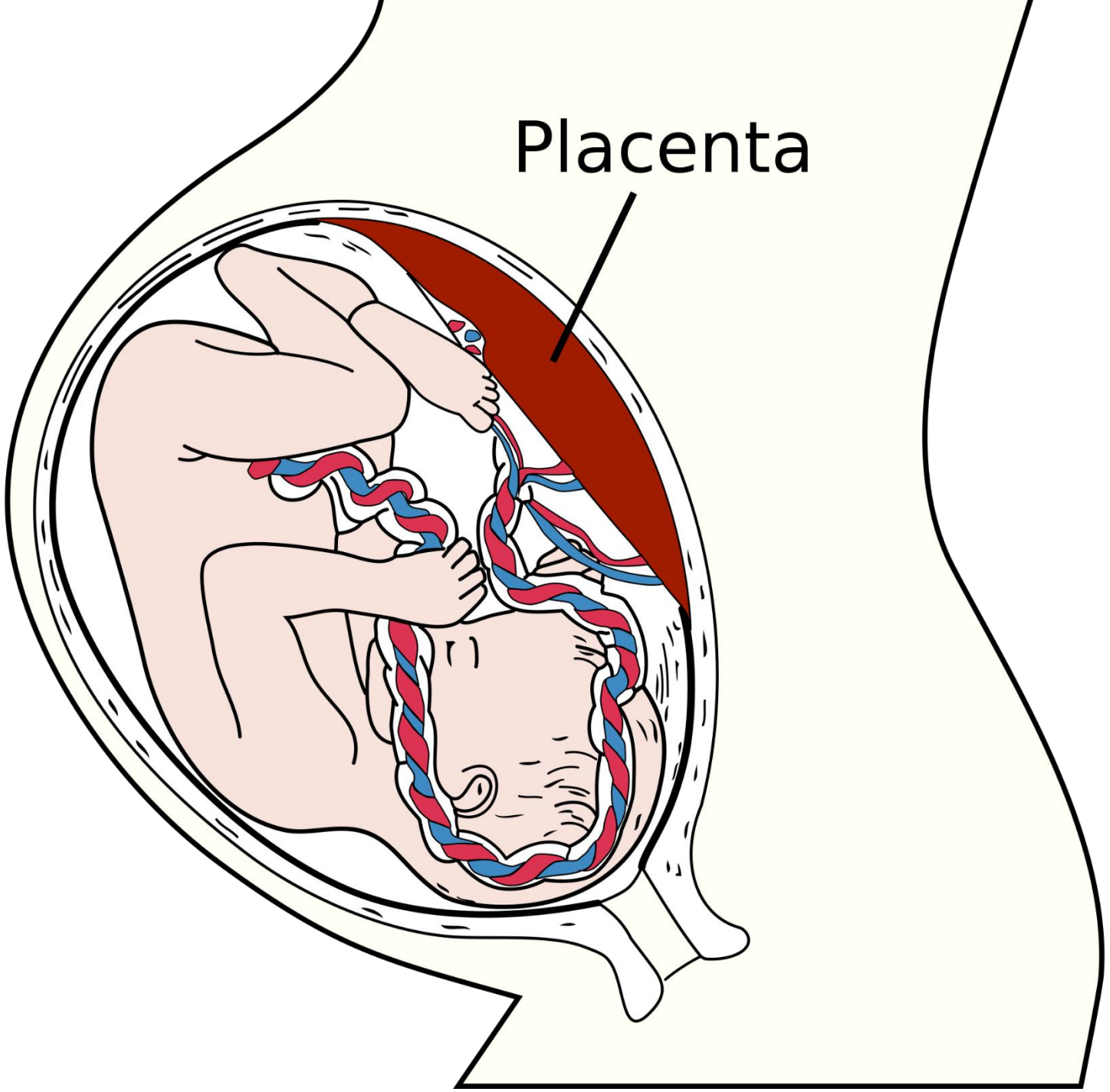
The first lizards and snakes likely gave live birth exclusively. The majority of snake and lizard ancestors were live-birthing creatures who adapted to lay protective eggs, only to adapt again and again for live birthing or egg laying, depending on ecological conditions.

Issue



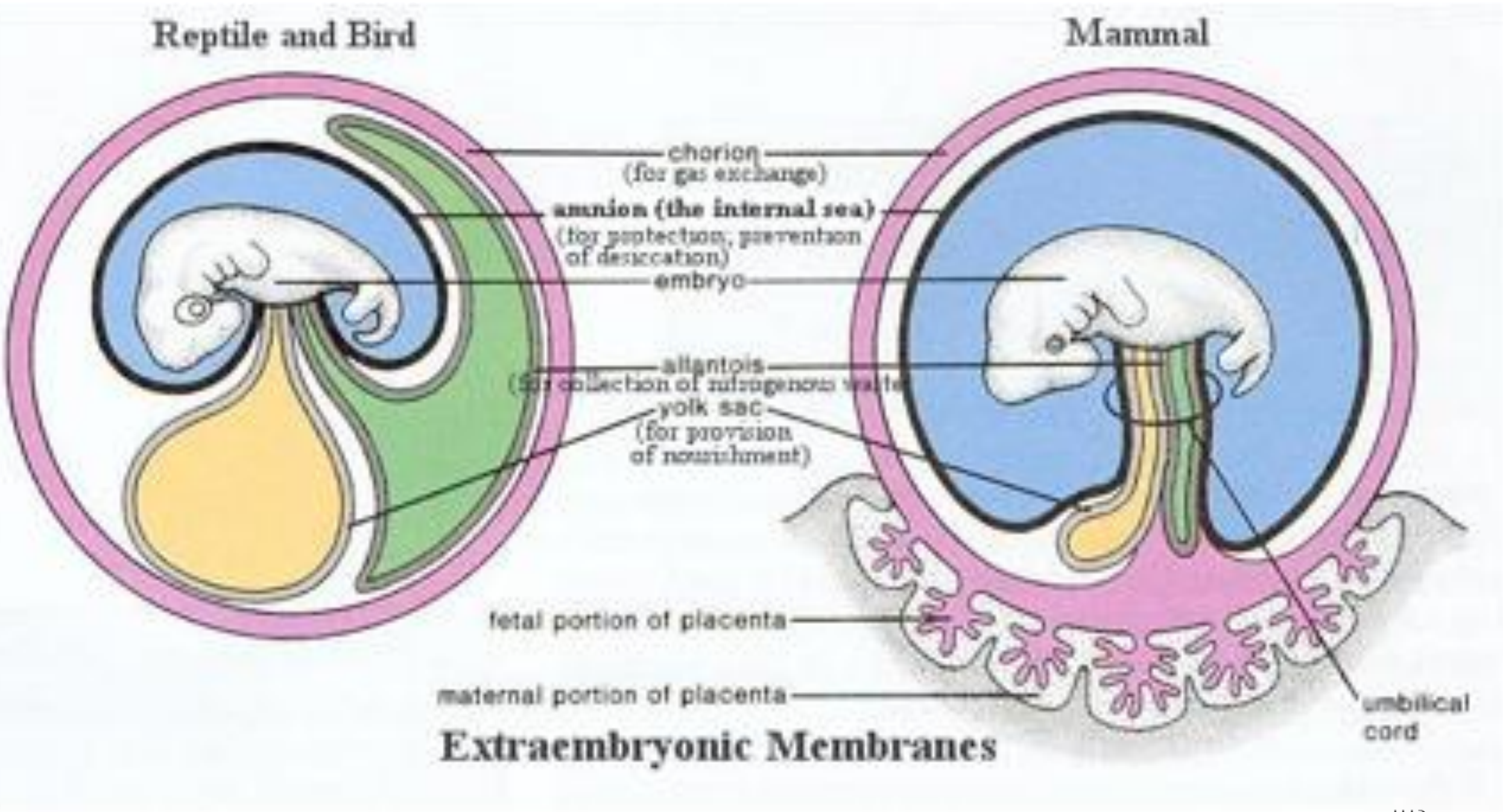
Ecology Letters

Volume 17, Issue 1, pages 13–21, January 2014



A fetomaternal organ with two components:

1. the **fetal placenta,** which develops from the trophoblast,
2. the **maternal placenta,** which develops from the maternal uterine tissue.



Extraembryonic Membranes

Conclusion

For all mammals (and for all reptile and all birds) the pregnancy process is ontologically (mereotopologically) identical. In each case there is a capsule involved to keep the foster separate from, but close to, the mother, and to ensure for the foster an appropriate avenue of (appropriately timed) escape.

For some mammals this capsule is an egg. For some mammals it is a pouch. For some mammals it is a multi-layered structure, the outer layer of which involves a unique fetal organ called the placenta.