



# Development of Animal Trait Ontology

Ina Hulsegge and Mari Smits



## EADGENE – SABRE Industry Days Rome – May 2009

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Animal Trait Ontology  
Industry Days – Rome, June 2009





## Outline



- ✦ **What is an ontology**
- ✦ **Animal Trait Ontology**
  - **REProduction Ontology (REPO)**
  - **Host-pathogen ontology for farm animals**



# What is an ontology?

Internet search for:  
Ontology



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## What is an ontology?

### Most quoted definition:

- ✦ An ontology is a description (like a formal specification of a program) of the concepts and relationships that can exist for an agent or a community of agents

Gruber 1993

### Simple definition:

- ✦ An ontology defines the terms used to describe and represent an area of knowledge
- Ontologies are used by computer programs, database and people: Shared understanding of what particular information means.
  - Ontologies include computer-usable definitions of terminology in the domain and the relationships among them.
  - Ontologies encode knowledge in a domain and also knowledge that spans domains. In this way, they make that knowledge reusable.

w3c 2004

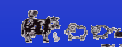
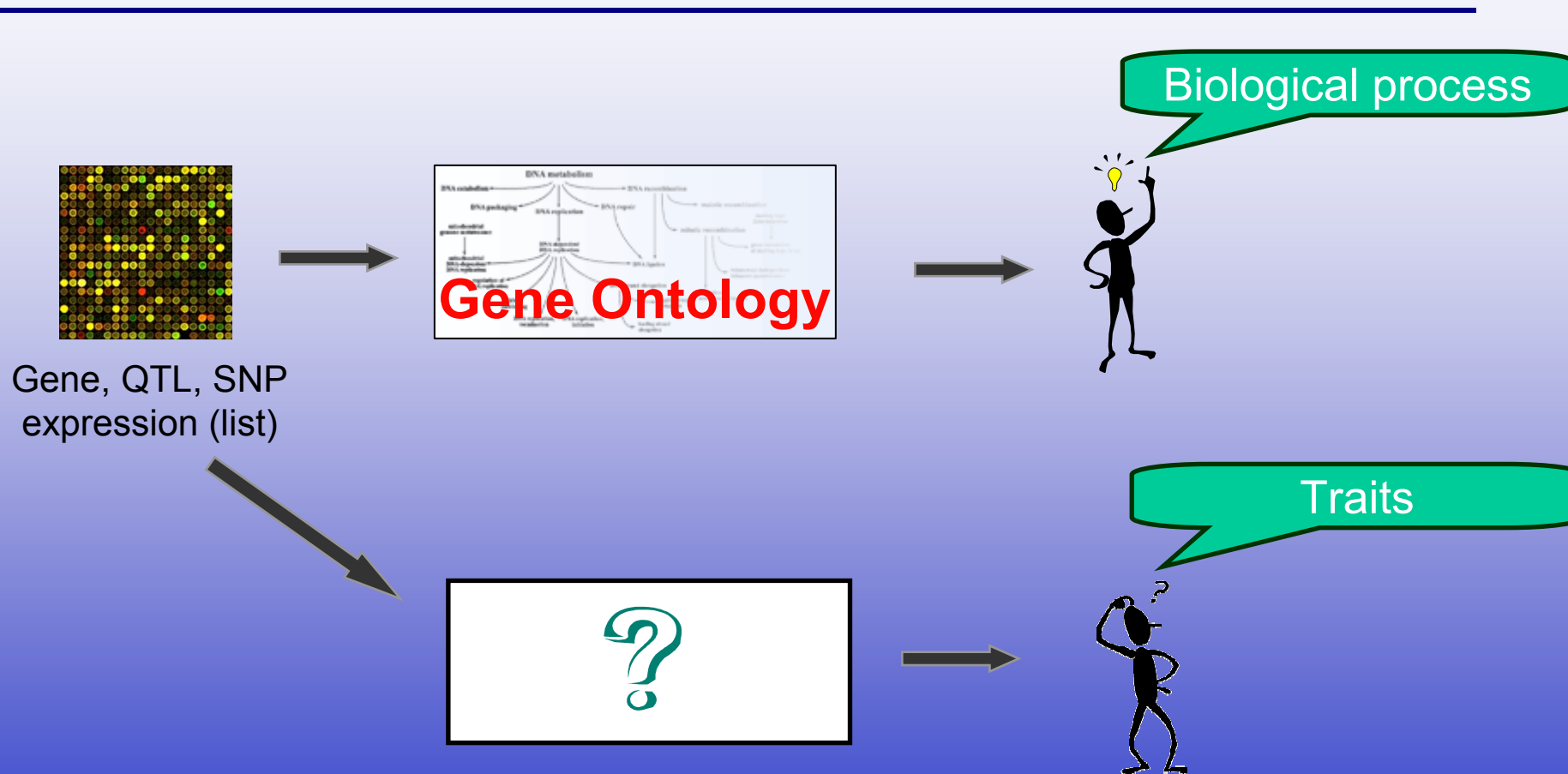
## Ontologies are good for:

- Controlled vocabulary for science and industry
- Representation of biological knowledge, shared by computers and humans consistently and precisely curating data
- Knowledge source for biological applications
  - Decision support
  - Natural language-processing
  - Data integration
- Standardised descriptions for making inferences
- User search
- Terms for annotating experimental data (increasing number of biological databases using ontologies to annotate data content)



# Ontology

SABRE 





## Animal Trait Ontology

- ✦ A collaboration has started between the U.S. (NRSP-8 Animal Trait Ontology Project) and Europe (EADGENE and SABRE) with the objective of developing a unified animal trait ontology (ATO).

- ✦ Aim ATO

Development of the Animal Trait Ontology (ATO) by including **trait information** for farm animals and aquaculture species and to create a database that will allow the linkage of the trait and other information (QTLs, SNPs, associations, ...) **within and across species** incl. mouse, rat, human, etc.

- scientific terminology ↔ industrial terminology





## REProduction Ontology (REPO)

- Development of a phenotype ontology database concerning reproduction traits of interest for livestock production
  - An ontology for terms, definitions and relationships of female fertility for use by animal production science and –industry
- Specific sub-domain of REPO
  - female fertility in cattle

RECOMMENDATIONS FOR STANDARDIZING  
BOVINE REPRODUCTIVE TERMS

By A  
COMMITTEE ON BOVINE REPRODUCTIVE NOMENCLATURE\*  
*Chicago, Illinois*

Received 22 Apr 1971

MANY have wrestled with the problem of describing adequately and accurately normal and abnormal phenomena relating to bovine reproduction. Communication difficulties arise when more than one definition or meaning is applied to the same term. Apart from confusion, the multiplicity of terms has made definition of bovine perinatal conditions difficult. Adoption of standardized definitions should make exchange of information simpler and clearer.

It is hoped that this report of the committee's findings will aid in understanding bovine reproduction and related



## REProduction Ontology (REPO)

- Collection of terms concerning reproduction traits of interest for livestock production

- Expert knowledge
- Internet searches
- Literature searches

- Development Thesaurus

- Wikisaurus

posted on the password protected  
SABRE Intranet for SABRE members

- Building ontology in  
Protege-owl



The screenshot shows the SABRE Wikisaurus interface. The main content area displays the title 'Reproductive performance (v.3)' and a section for 'REPRODUCTIVE PERFORMANCE'. Under 'Definition:', there is a list of 'Narrower Term's including: Age at first conception, Age at first parturition, Age at first service, Age at puberty, Calf crop, Calving index, Cyclicity, Ease of parturition, Oestrous cycle, Parturition interval, Parturition percentage, Progesterone level, Rate, Reproductive index, Services per conception, and Voluntary waiting period. A 'Related Term' section lists Fertility and Reproductive behaviour. A 'Used For' section lists Breeding performance, Mating performance, Reproductive ability, Reproductive capacity, Reproductive efficiency, and Reproductivity. On the right, a 'WikiSaurus Pages' sidebar lists various terms like Abortion, Anestrus, Animal behaviour, Anoestrus, Artificial insemination, Assortative mating, Attempted mounts, Be mounted by other animals, Behavior, Behaviour, Birth, Birth rate, Birth weight, Birthweight, Breeding behavior, Breeding behaviour, Breeding performance, Calving, Calving ease, and a pagination bar at the bottom showing 'Page 1 of 8'.

Screenshot wikisaurus

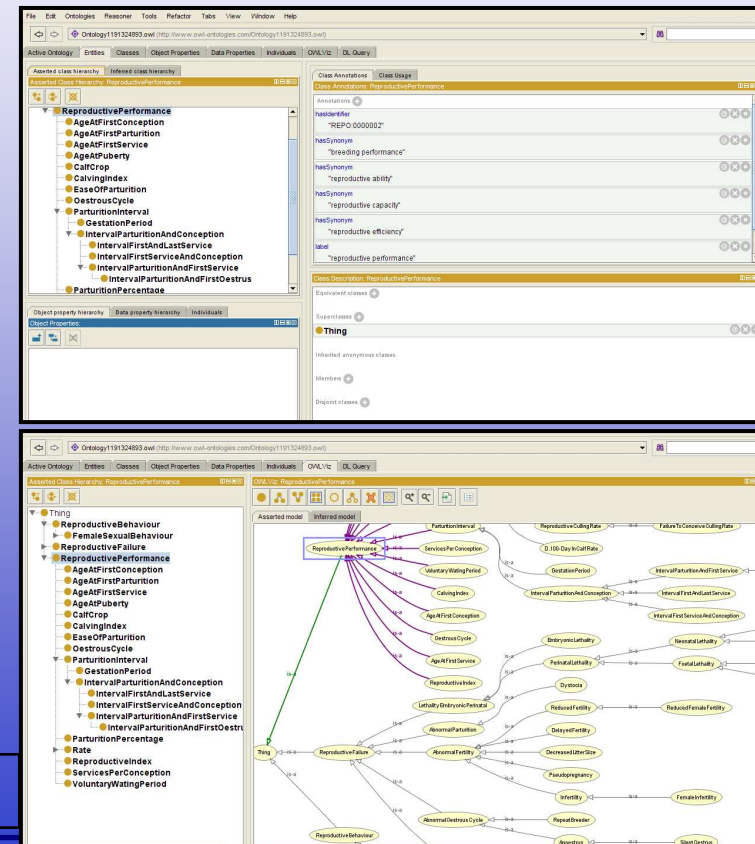
# REProduction Ontology (REPO)

Subdomain: female fertility in cattle

The top level terms of REPO

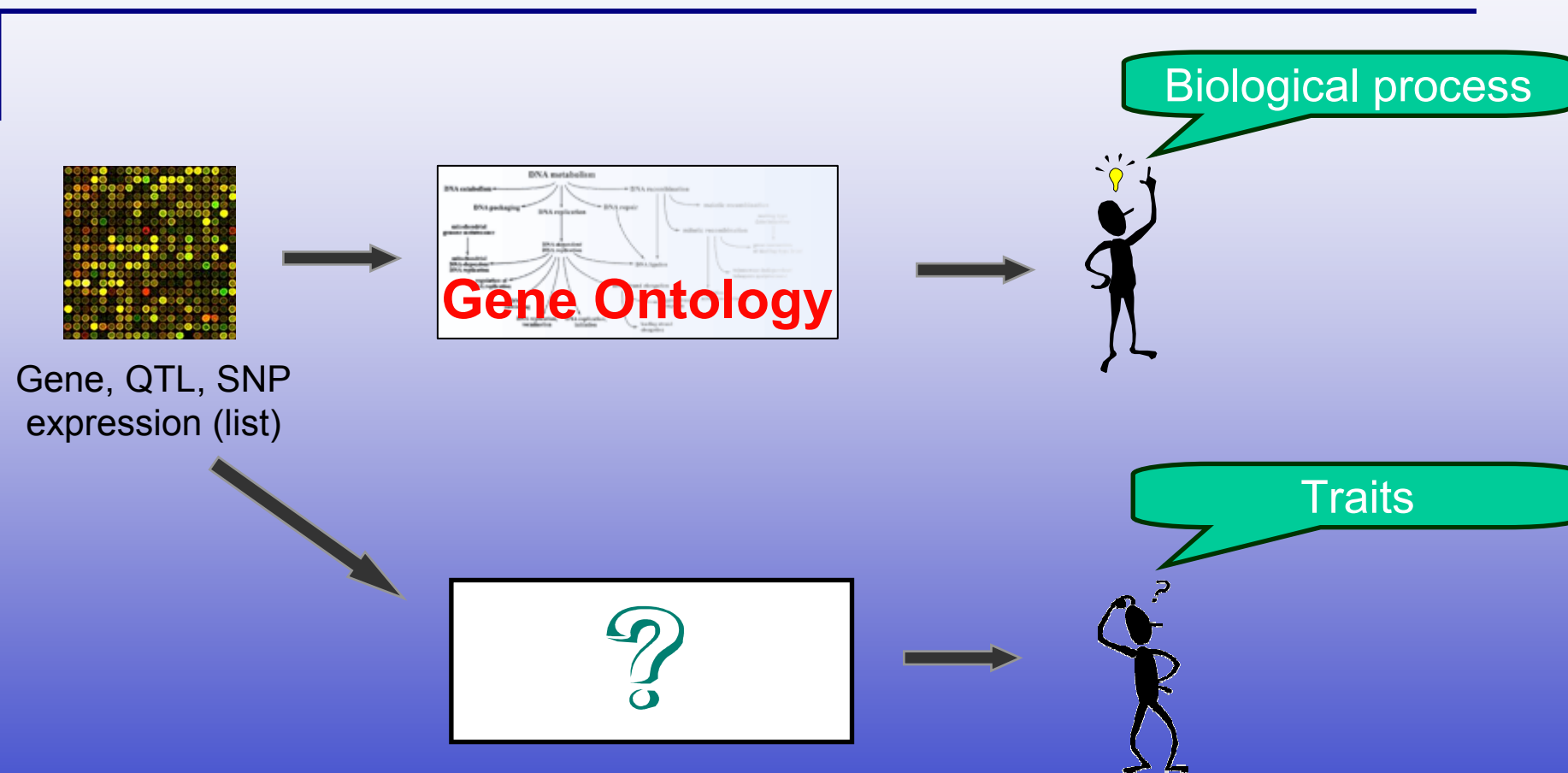
- ✦ Reproductive Performance
- ✦ Reproductive Behaviour
- ✦ Reproductive Failure

Screenshots protégé

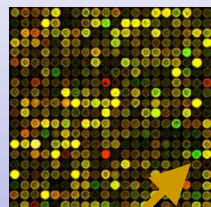


Animal Trait Ontology  
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## Example

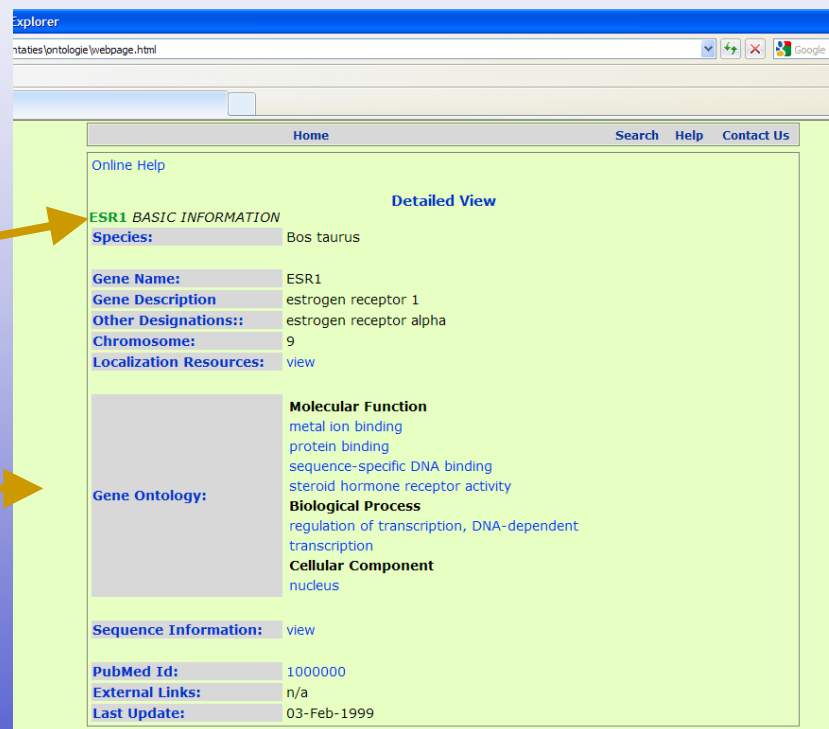


## Example



Gene **ESR1**

Biological process

explorer

ntates/ontology/webpage.html

Home Search Help Contact Us

Online Help

**ESR1** BASIC INFORMATION

Species: Bos taurus

Gene Name: ESR1

Gene Description: estrogen receptor 1

Other Designations: estrogen receptor alpha

Chromosome: 9

Localization Resources: [view](#)

Gene Ontology:

**Molecular Function**

- metal ion binding
- protein binding
- sequence-specific DNA binding
- steroid hormone receptor activity

**Biological Process**

- regulation of transcription, DNA-dependent
- transcription

**Cellular Component**

- nucleus

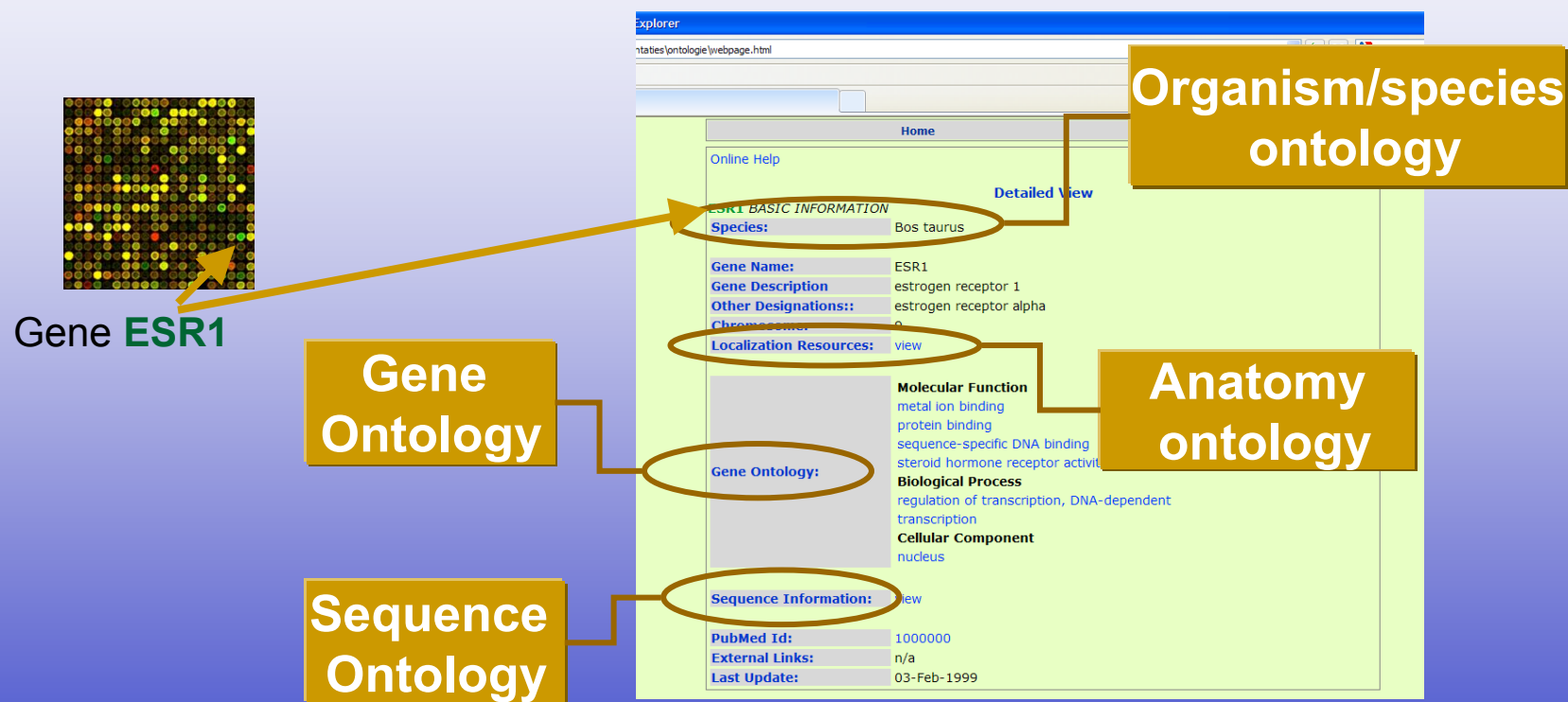
Sequence Information: [view](#)

PubMed Id: 1000000

External Links: n/a

Last Update: 03-Feb-1999

## Example



Gene **ESR1**

**Organism/species ontology**

**Gene Ontology**

**Anatomy ontology**

**Sequence Ontology**

**ESR1 BASIC INFORMATION**

**Species:** Bos taurus

**Gene Name:** ESR1

**Gene Description:** estrogen receptor 1

**Other Designations:** estrogen receptor alpha

**Localization Resources:** [view](#)

**Gene Ontology:**

**Sequence Information:** [view](#)

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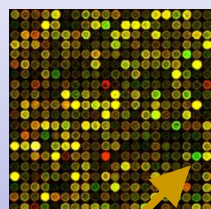
- nucleus

**PubMed Id:** 1000000

**External Links:** n/a

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## Example



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Traits



explorer

ntates/ontologie/vebpage.html

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**Animal Trait Ontology:**

**Trait**

- infertility
- proceptive behaviour
- female sexual behaviour

Sequence Information: view

PubMed Id: 1000000

External Links: n/a

Last Update: 03-Feb-1999

Animal Trait Ontology:

Tra  
inf  
pro  
fer

# REProduction Ontology (REPO)



**Animal Trait Ontology** AmiGO

Search Browse ATO Slimmer Help

Search GO  ☐ terms ☐ exact match

## Tree Browser

**Filter tree view**

Filter by ontology

Ontology

- All
- feed consumption
- First rib backfat
- loin height

View Options

Tree view ☒ Full ☐ Compact

all : all [0 trait details]

- ATO:0000346 : ATO [0 trait details]
- ATO:0000348 : Bos taurus [0 trait details]
- ATO:0001225 : Development (cattle) [0 trait details]
- ATO:0000354 : Exterior (cattle) [0 trait details]
- ATO:0000349 : Immune Function (cattle) [0 trait details]
- ATO:0001228 : Product Quality (cattle) [0 trait details]
- ATO:0000352 : Production (cattle) [0 trait details]
- ATO:0000353 : Reproduction (cattle) [0 trait details]**
- ATO:0000482 : Gallus gallus [0 trait details]
- ATO:0000347 : Sus scrofa [0 trait details]

Actions...

- Last action: Closed
- ATO:0000353
- Graphical View
- Permalink
- Download...
- OBO
- RDF/XML
- GraphViz dot

NAGRP - Bioinformatics Coordination Program  
ATO Contact: NAGRP Bioinformatics Team

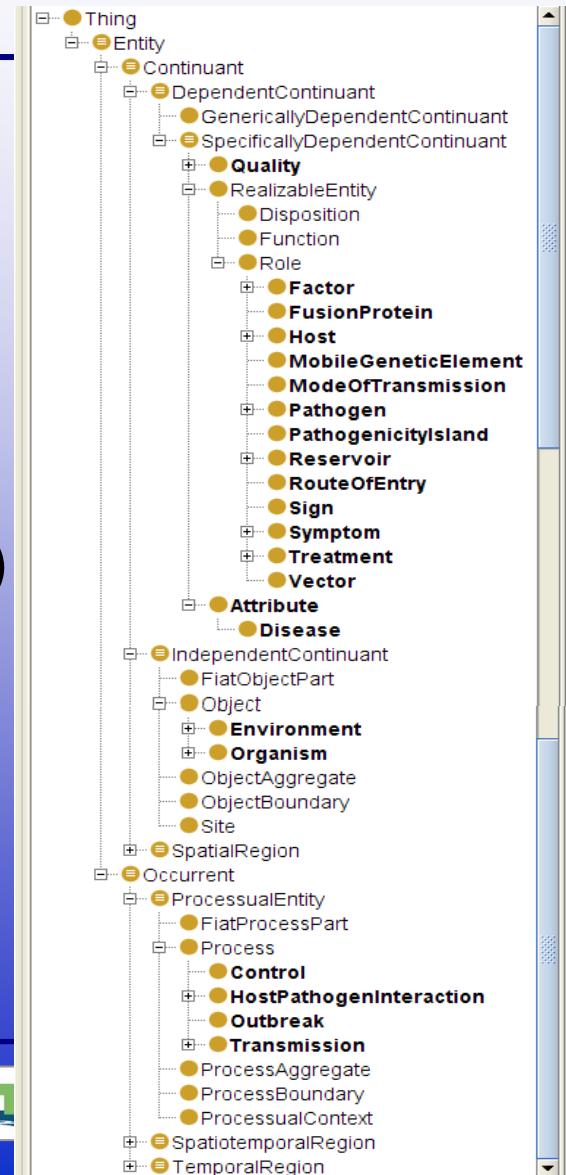
AmiGO: Terms of use • GO helpdesk  
Copyright © 1999-2008 the Gene Ontology

<http://www.animalgenome.org/cgi-bin/amigo/browse.cgi>



## Host-pathogen ontology for farm animals

- ✦ Development of a host-pathogen ontology for farm animals.
- ✦ **Subdomain:** salmonella – pig.
- ✦ **Reuse:** Reuse ontologies (or parts)
  - ✦ Infectious Disease Ontology (human)
  - ✦ Gemina
  - ✦ Transmission ontology
  - ✦ .....

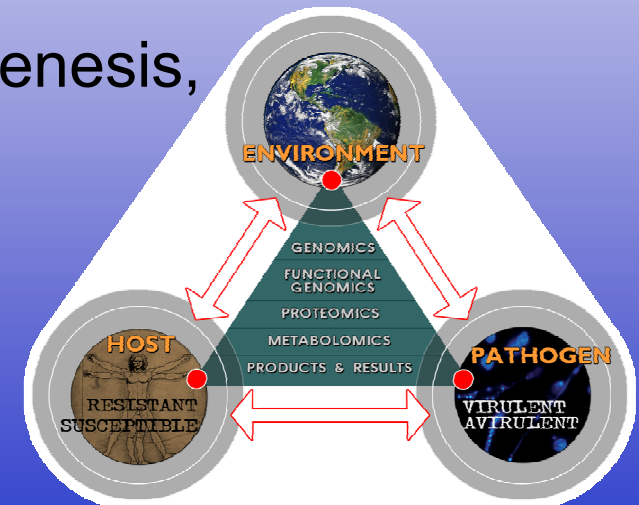


## Host-pathogen ontology

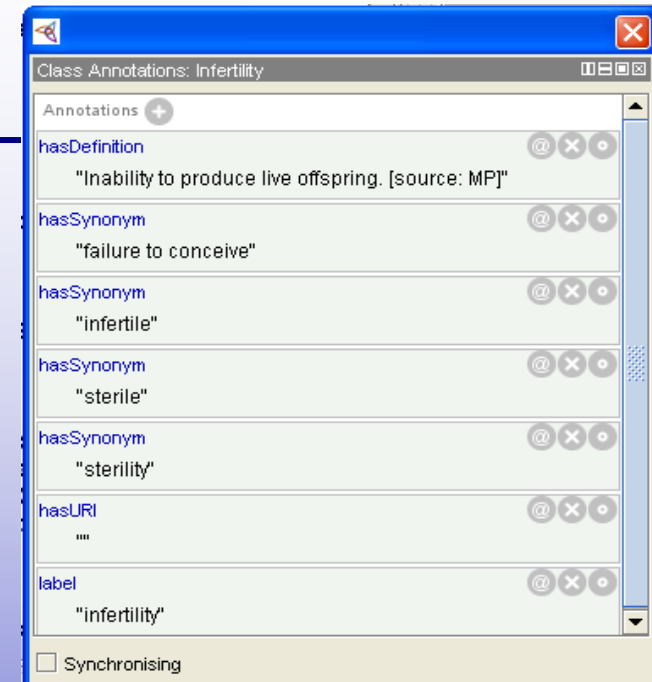
### Scope

- ✦ **Scales:** molecules, cells, organisms, populations
- ✦ **Organisms:** host, pathogen, vector, model organisms, interactions between them
- ✦ **Domains:** biological, clinical care, health
- ✦ **Diseases:** etiology, nature of pathogenesis, signs, symptoms, treatments

Lindsay Cowell

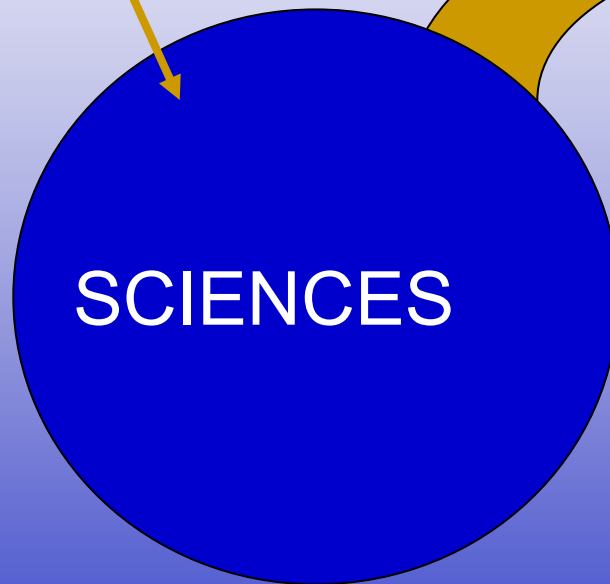


- ✦ Terms
- ✦ Synonyms: They facilitate searching the ontology.
  - Different words that mean the same thing.
- ✦ Definitions: Each term should have a definition. A Definition explains clearly what is meant by a particular term. A definition must have a reference to it's origin. (PubMed, database, website, the person that created it).
- ✦ Understanding relationships: Some type are: is\_a, part\_of and derived\_from



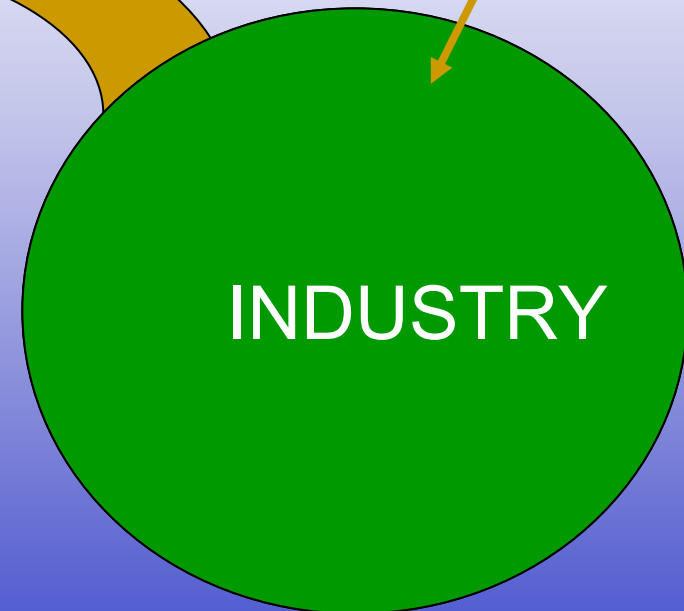
## Requirements

vocabulary



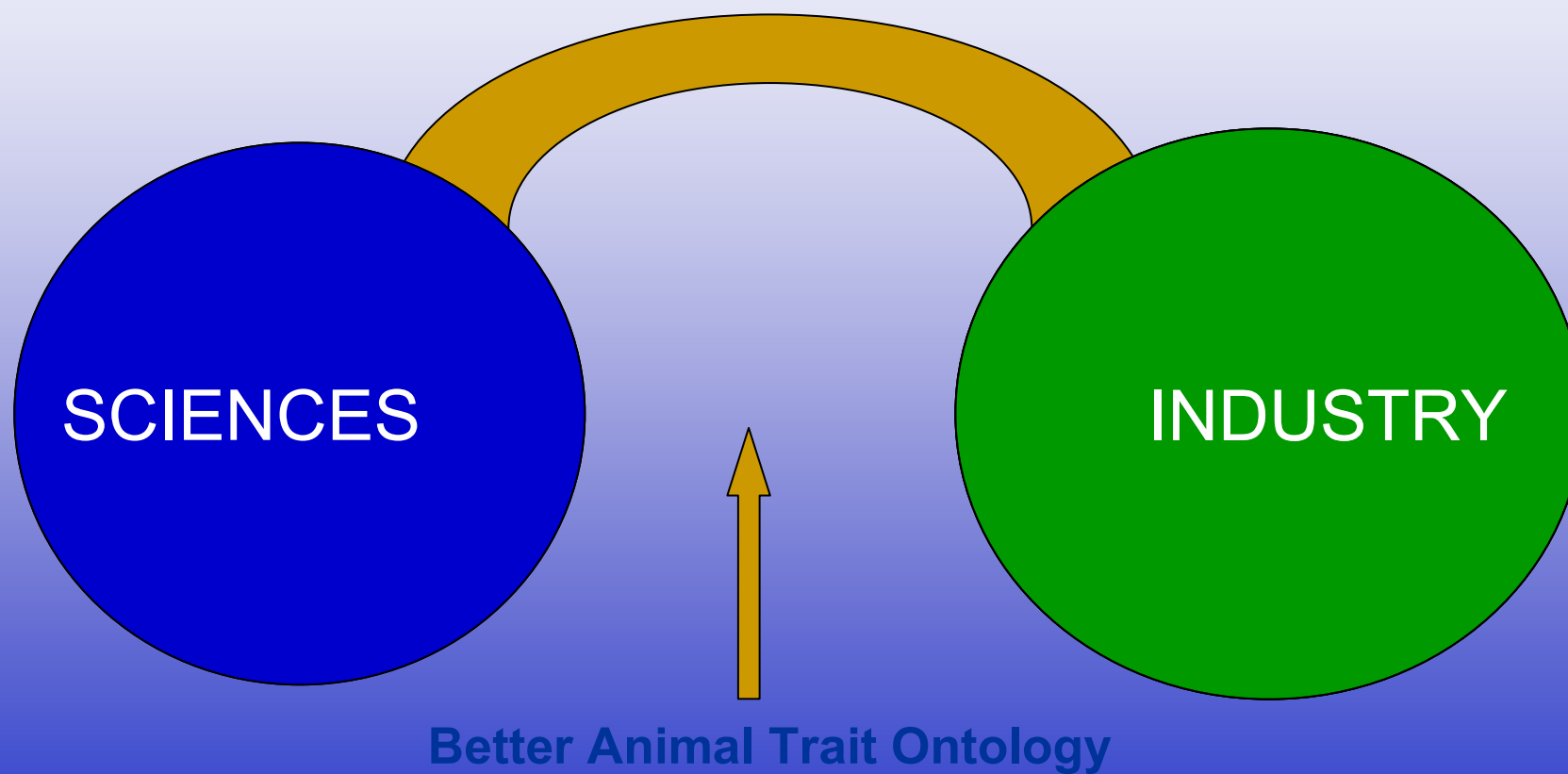
SCIENCES

vocabulary



INDUSTRY

## Requirements





## Acknowledgements



WP5



WP6 and WP3



KB

