FoodOn Evolution and the Food Ontology Ecosystem



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Agricultural Research Service



THE UNIVERSITY
OF BRITISH COLUMBIA





GenomeCanada

16th September 2020

Overview

- How FoodOn began
- Food vocabulary needed: human and animal health, agriculture, anatomy, chemistry, metabolomics, cultural ...
- OBOFoundry curation community
- Food product example
- Tools and agency projects

19th May 2020 Damion Dooley

Public health and the globalized food supply

2011: E. coli 0104:H4

Germany May 1st Epidemic Announcement

4,000+ ill; 47 fatalities

16 countries70 companies

Cucumbers, tomatoes, leafy vegetables ??? 200 million Euro/week cost to Spain!





Egyptian fenugreek seeds

Fast and accurate detection of pathogens is critical

Similar Epi/Clinical d

GIOF BC Centre for Dise An agency of the Provincial Health State: 1. Date and time of onset Fax to Environ of first symptoms: Mo. Day **OUTBREAK IDENT** Outbreak ! CONTACT NAME: Hour am (1) CONTACT TELEPHO Results: NAME OF 4. Admitted 3. Total INSTITUTION/EVENT duration of ADDRESS: illness: CITY: POSTAL CODE: CDC Atlanta, TELEPHONE: BC CDC, WHO Questions re: diseas ONSET DATE OF NUMBER OF PA

TOTAL NUMBER

Example of an outbreak report form used by the WHO Surveillance Programme for Control of Foodborne Infections and Intoxications in Europe

	Report of incident					
1. Country:			2. Year:	3. Report no.:		
4.	Place of incident: City/Town: Province/District:					
5.	Causative agent/type: Code: Code: Confirmed: Presumed: Presumed: Confirmed:					
6.	Number of persons: at risk ill hospitalized died					
	by age groups from 0 to 4 yea from 4 to 15 ea from 15 to 60 y over 60 years	ars				
7.	Symptoms: Nausea Fever	□ Vomiting□ Neurologica	1.000	☐ Abdominal pair		
8.	Date of onset	of illness:	las	t person: / / _		



FoodOn 2017

http://foodon.org



+ LanguaL™ born ~1975

http://langual.org



A global food product description ontology encompassing the farm-to-fork journey

OBOFoundry.org

A family of > 50 orthogonal ontologies.

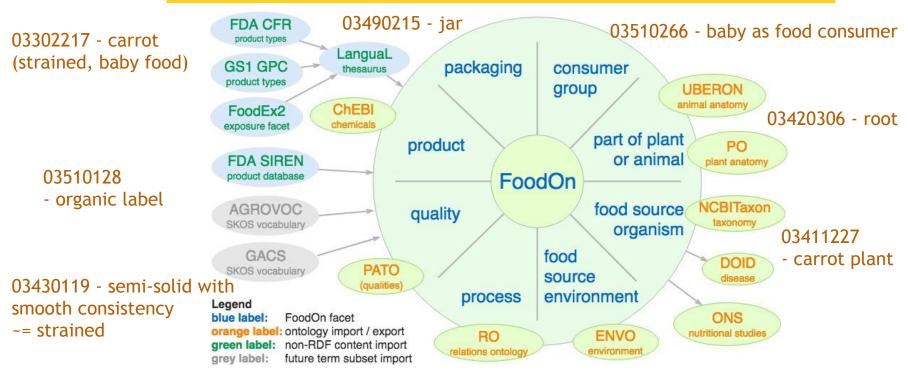
Like volumes of an encyclopedia all organized under a general Basic Formal Ontology.

Each volume has its own curation community.

bfo	Basic Formal Ontology (cc) BY	The upper level ontology upon which OBO Foundry ontologies are built. Detail
chebi	Chemical Entities of Biological Interest	A structured classification of molecular entities of biological interest focusing on 'small' chemical compounds. Detail
doid	Human Disease Ontology (0) PUBLICHOMAIN	An ontology for describing the classification of human diseases organized by etiology. Detail
go	Gene Ontology	An ontology for describing the function of genes and gene products Detail
obi	Ontology for Biomedical Investigations	An integrated ontology for the description of life- science and clinical investigations Detail

FoodOn Facets - a shopping bag

"Organic mashed carrot baby food, jarred"

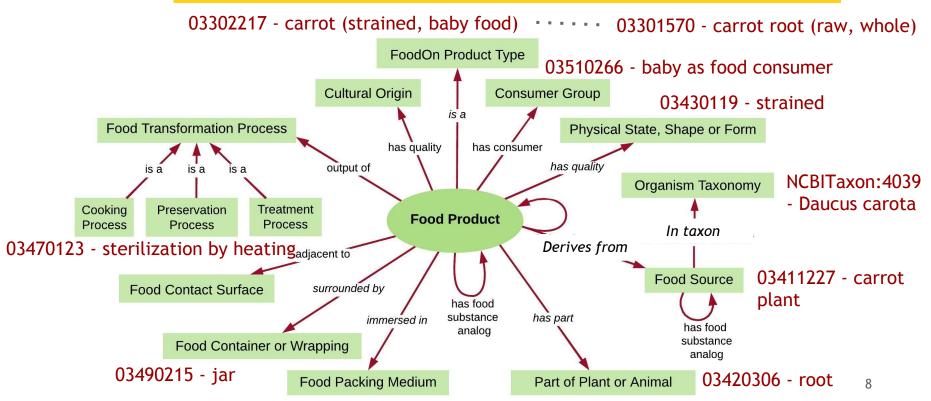


03470123 - sterilization by heating

ENVO:00000114 - agricultural. field

FoodOn Facets - relations

"Organic mashed carrot baby food, jarred"



Food Ontology Ecosystem

Joint Food Ontology Workgroup: https://github.com/FoodOntology/joint-food-ontology-wg



PO2

Process and Observation Ontology

DOID

Human Disease Ontology

FIDEO

Food Interactions with Drugs

FOBI

Food-Biomarker Ontology

<u>ONS</u>

Ontology for Nutritional Studies

FoodOn

Food source organism and food product description

CDNO

Crop Dietary Nutrition Ontology

ENVO

Environment Ontology

PO

Plant Ontology:

Plant anatomy, morphology and development

CHEBI

Chemicals of Biological Interest

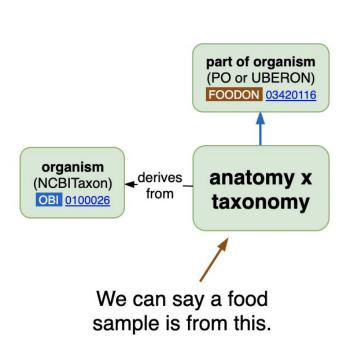
NCBITaxon

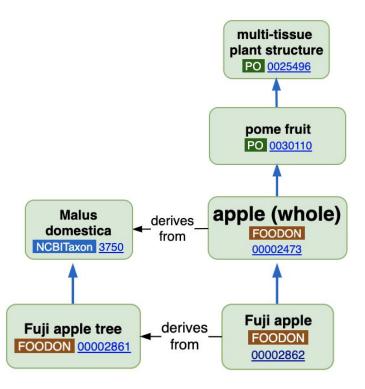
Taxonomy

PATO

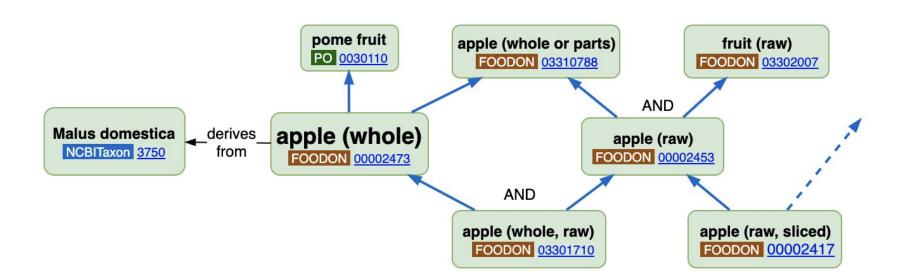
Phenotypic Qualities

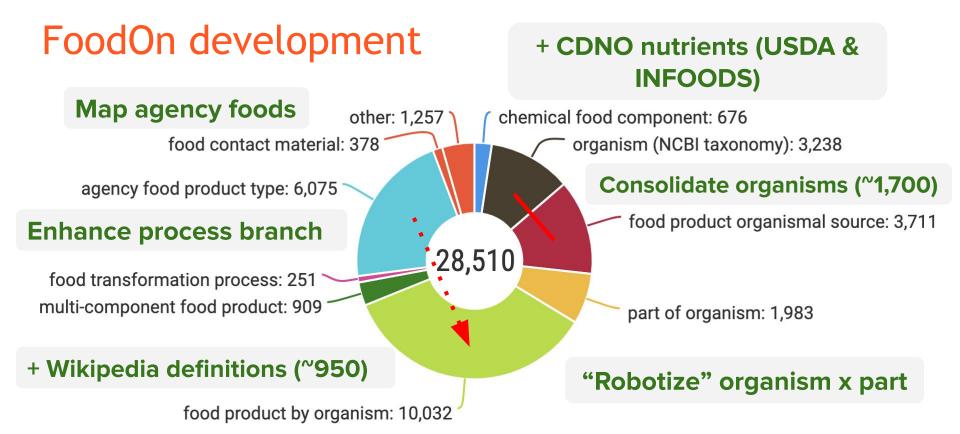
Basic food patterns





Basic food patterns





Agency integration

- USDA Agricultural Research Service <u>Food Data Central</u>
- NARMS, GenomeTrakr, and IFSAC epidemiology-focused food classification schemes (foodborne disease; US FDA, CDC, USDA)
- Minimum Information about any (x) Sequence Food Environmental Metadata Standard (MIxS). (US FDA)
- Upcoming mapping of EFSA FoodEx2 exposure hierarchy vocabulary and INFOODS nutrient codes.

GEEM ontology driven data specifications

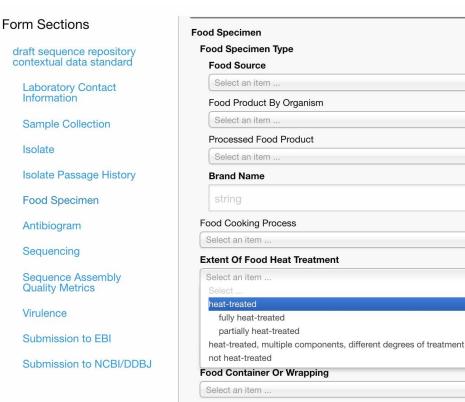


ISO/TC Workgroup 34/SC 9
NP23418: "Microbiology of the
Food Chain — Whole Genome
Sequencing, Typing and Genomic
Characterization of Foodborne
Bacteria".

International Organization for Standardization

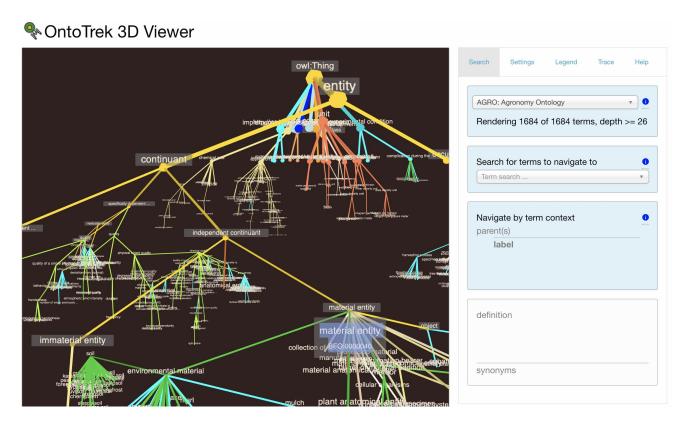
"Over twenty thousand standards have been set covering everything from manufactured products and technology to food safety, agriculture and healthcare."

https://genepio.org/geem/



https://genepio.org/geem/form.html#GENEPIO:0002083

The ontology universe



http://genepio.org/ontotrek/

Bean

A shortcut so people don't have to model pod mereology

bean food product FOODON:00001635

derives from

bean plant FOODON:<u>03411567</u>



A shortcut so people don't have to model pod mereology

bean food product FOODON:00001635

derives from

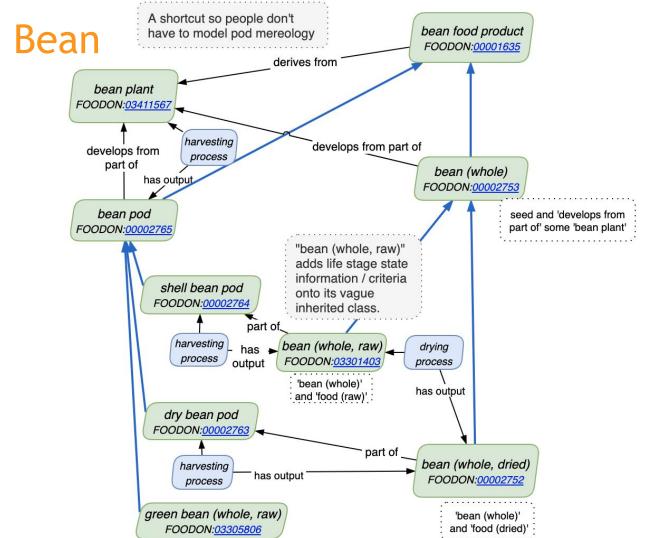
bean plant FOODON:03411567

develops from part of

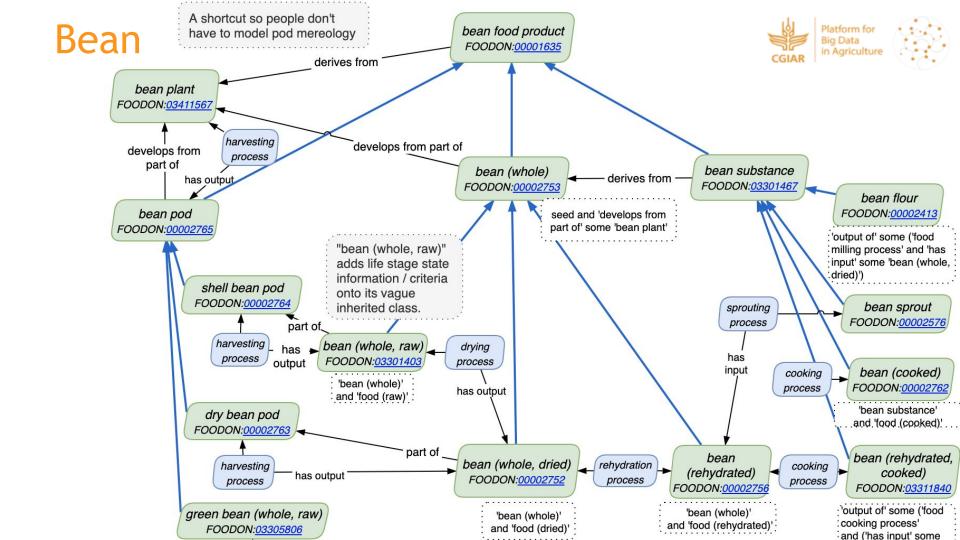
bean (whole) FOODON:00002753

seed and 'develops from part of' some 'bean plant'



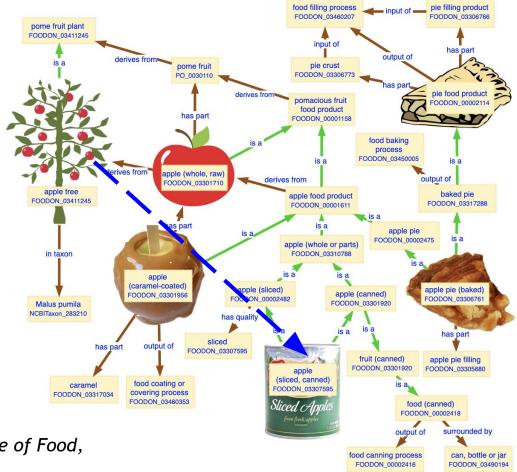






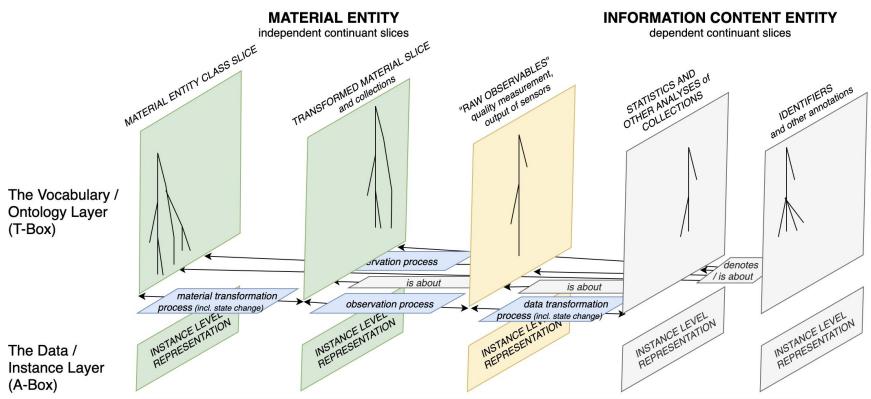
FoodOn farm-to-fork

Describing food products all the way from farm field or hunting excursion to dinner plate



Dooley, Griffiths et al (2018), *Nature: Science of Food*, https://www.nature.com/articles/s41538-018-0032-6

Ontology layers / slices



The terminology of each slice is disjoint from terminology on other slices since processes separate them. Time flows from left to right, and most slices are the product of process(es).

LanguaLTM history across the Atlantic

Food ID: 01085 Data Sourca: USDA Food Name: SKIM MILK, WITH VITAMIN A ADDED Scope Note: RAM AND PASTELECTED. A148 MILK OR MILK PRODUCT B1201 COM C235 MIIK LIQUID, LOW VISCOSITY, WITH NO VISIBLE PARTICLES DEGREE OF PREPARATION NOT INCHA COOKING METHOD NOT APPLICABLE VITAMIN A ADDED FAT FULLY REMOVED PRESERVATION METHOD NOT KNOWN [Pg Dn] -> more or [ESC] to quit

LanguaLTM

Danish, French, Swiss, Hungarian partners

Figure 10: FFV Verification Screen

[Pg Up] -> names

Food Component Research Database 1989 1992

US National Cancer Institute (NCL)

Food ID: 01085

Product Type: A148

Food Source: B1201

Part of Plant/Animal: C235 Physical State/Shape/Form: E123

Degree of Preparation: F01 Cooking Hethod: G003

Preservation Method: J001

Container or Wrapping: MO01
User Group: P24 P P P

Packing Medium: KD3

Figure 9: FFV Entry Screen

1996

Committee

Version 0 release

European Langual Technical

Langual.org website 30,000+ food items

2000

1988

Factored Food Vocabulary (FFV)
US FDA Center for Food Safety
Applied Nutrition (CFSAN)

1975