Embedding the routine use of ontologies to promote best use of evidence in behavioural science:

A Workshop

Robert West

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BCIO part of HB/CP

UCL CENTRE FOR BEHAVIOUR CHANGE

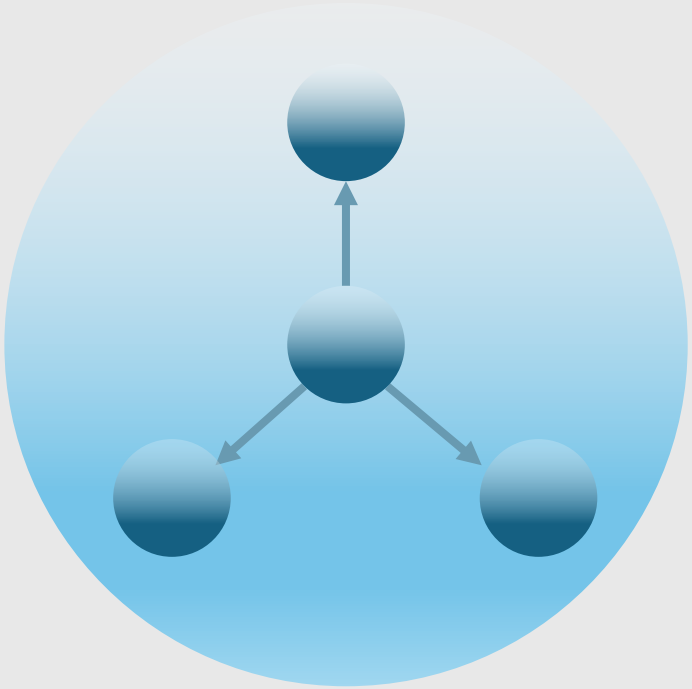
CONFERENCE

10th Anniversary Edition

www.ibtnetwork.org

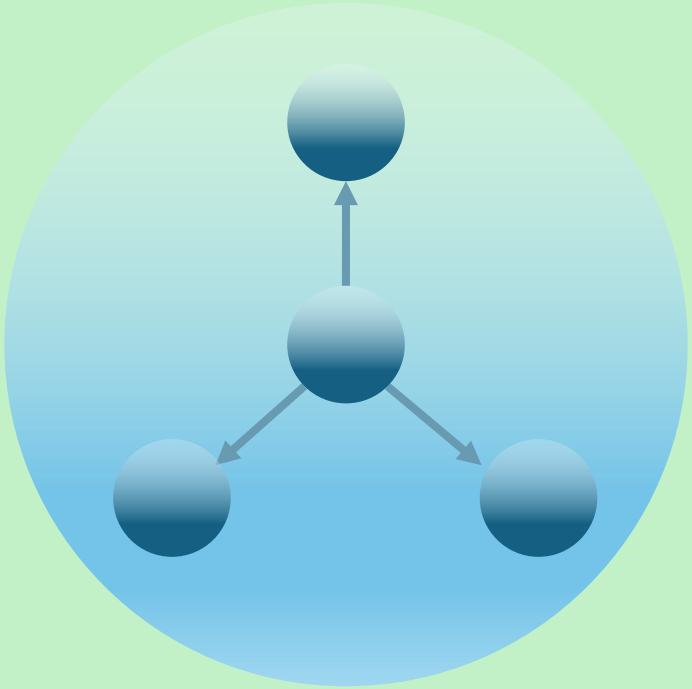
ibtn international behavioural trials network

Workshop programme

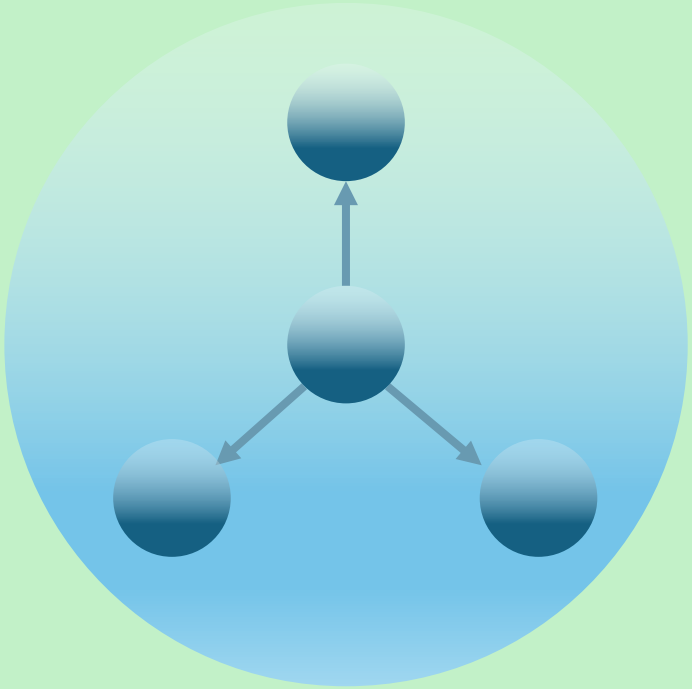


8.30-8.45	Introduction and overview of session
8:45-9:15	What are ontologies and how are they used in science?
9:15-9.30	What is the Behaviour Change Intervention Ontology (BCIO) and what does it cover?
9:30-10:15*	Finding ontology classes in the BCIO and related ontologies
10:15-10.45	**Break**
10:45-11:00*	Seeing how ontology classes relate to each other
11:00-11:45*	Using ontologies to characterise interventions
11:45-12:00	Discussion and next steps

*Practical exercise

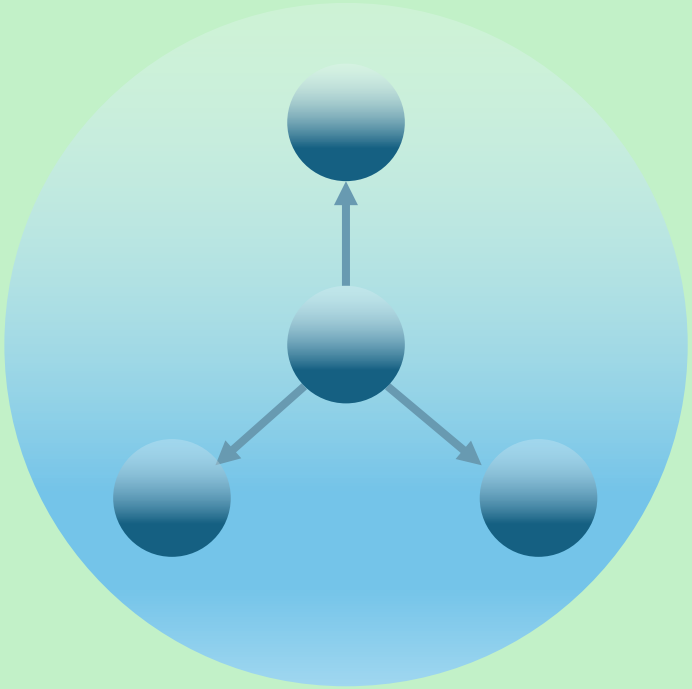


Introduction and overview of the session



The aims of the workshop are:

1. To engage participants in the use of ontologies in their work
2. To give users practical experience of using ontologies to characterise interventions in protocols and study reports



This is an interactive workshop so you can ask questions at any time

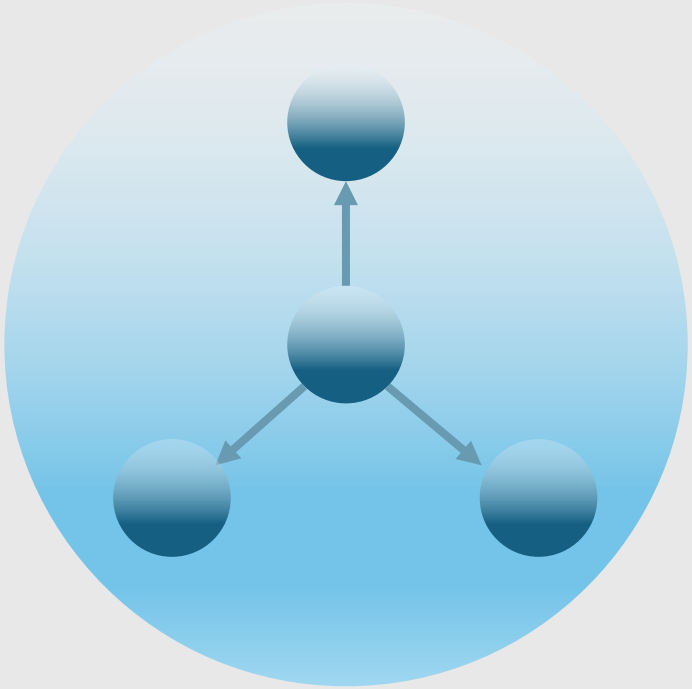
We will pause regularly and invite questions and discussion

There will be ONLINE DEMOS

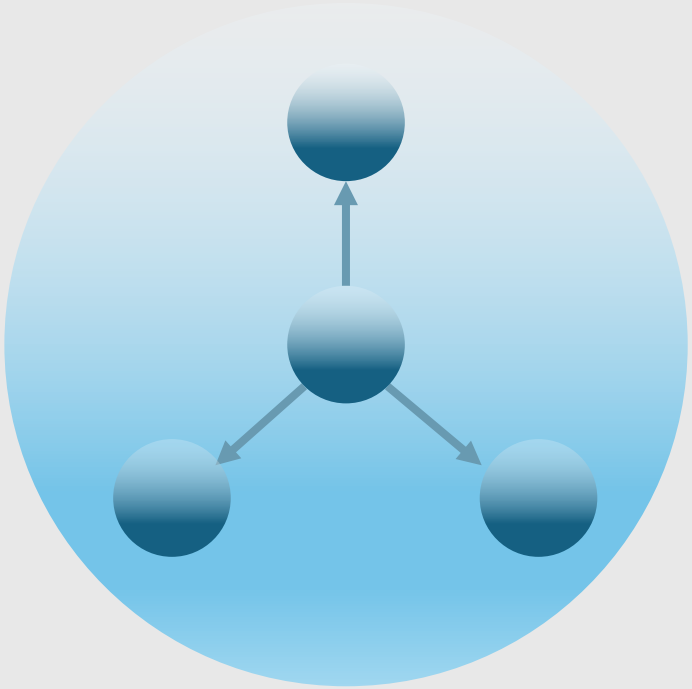
EXERCISES

We will ask ARE YOU CLEAR ABOUT ...?

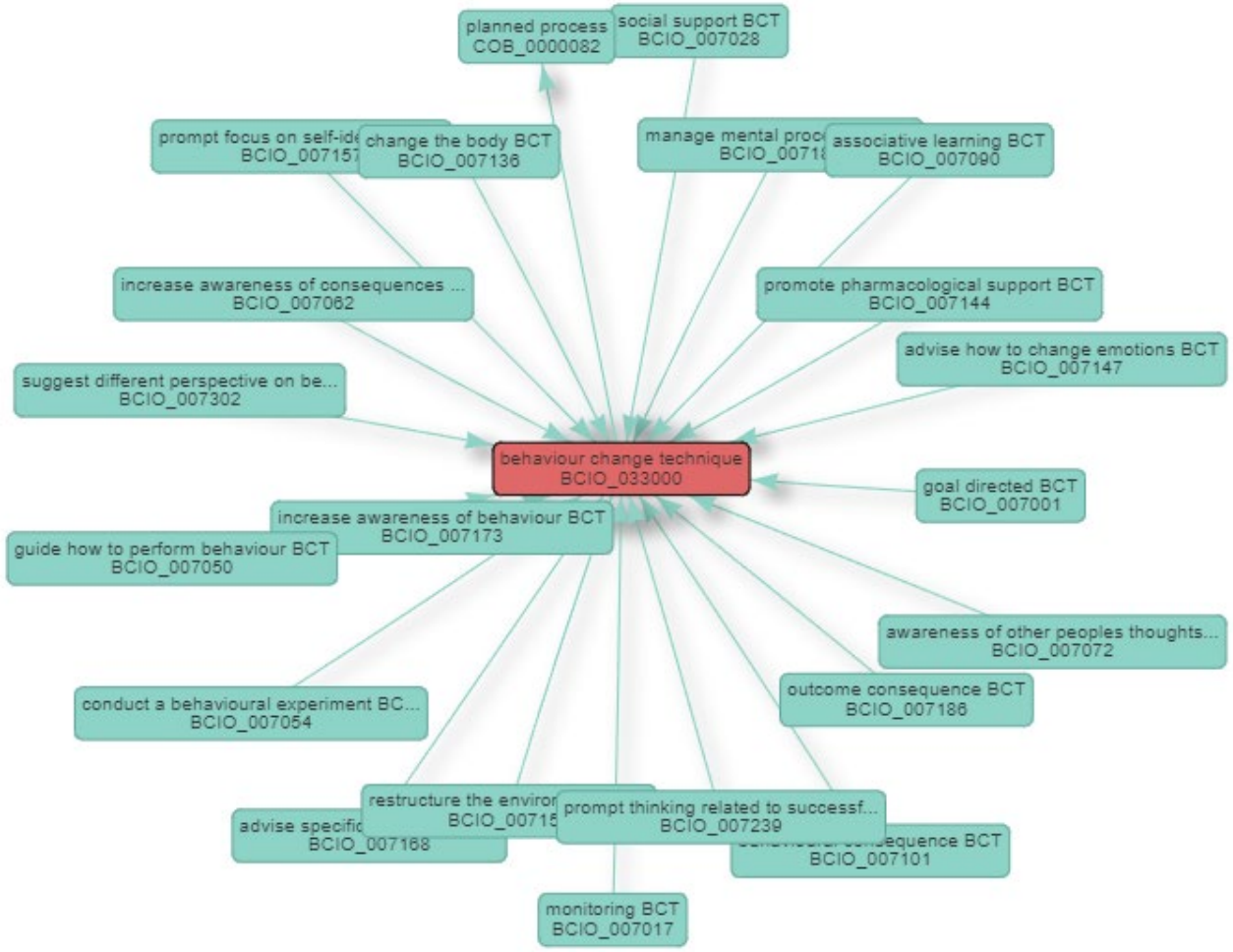
There will be exercises for which you will need a laptop and access to the internet



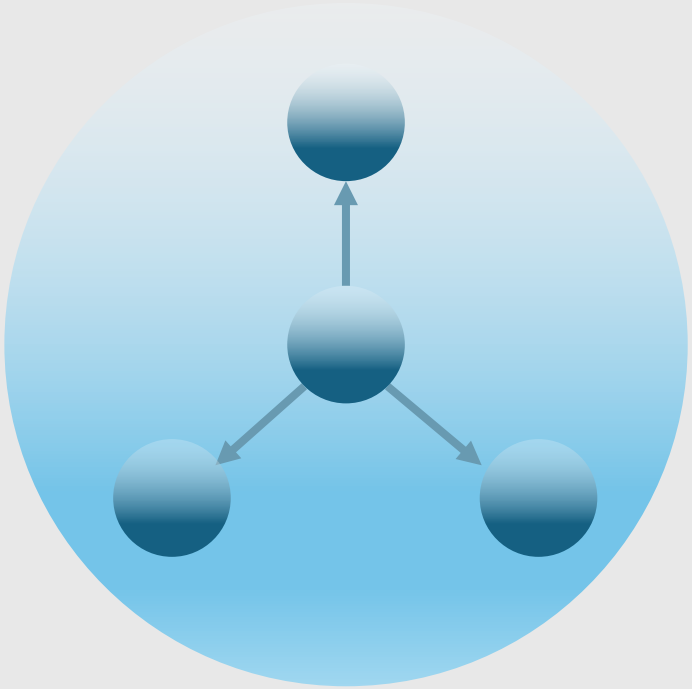
What are ontologies and how are they used in science?



ONLINE DEMO


planned process
COB_0000082
social support BCT
BCIO_007028
change the body BCT
BCIO_007136
associative learning BCT
BCIO_007090
increase awareness of consequences ...
BCIO_007062
promote pharmacological support BCT
BCIO_007144
advise how to change emotions BCT
BCIO_007147
suggest different perspective on be...
BCIO_007302
behaviour change technique
BCIO_033000
goal directed BCT
BCIO_007001
increase awareness of behaviour BCT
BCIO_007173
guide how to perform behaviour BCT
BCIO_007050
awareness of other peoples thoughts...
BCIO_007072
outcome consequence BCT
BCIO_007186
conduct a behavioural experiment BC...
BCIO_007054
prompt thinking related to successf...
BCIO_007239
monitoring BCT
BCIO_007017

What are ontologies?

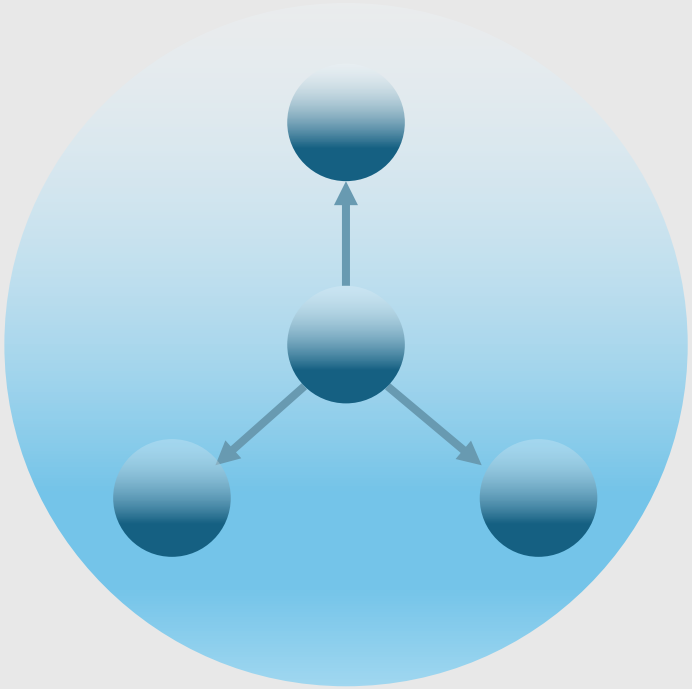


A structured way of **representing things** in the world to promote:

- Clarity
- Consistency
- Coherence
- Connectivity

They are used in science, industry and government to organise information

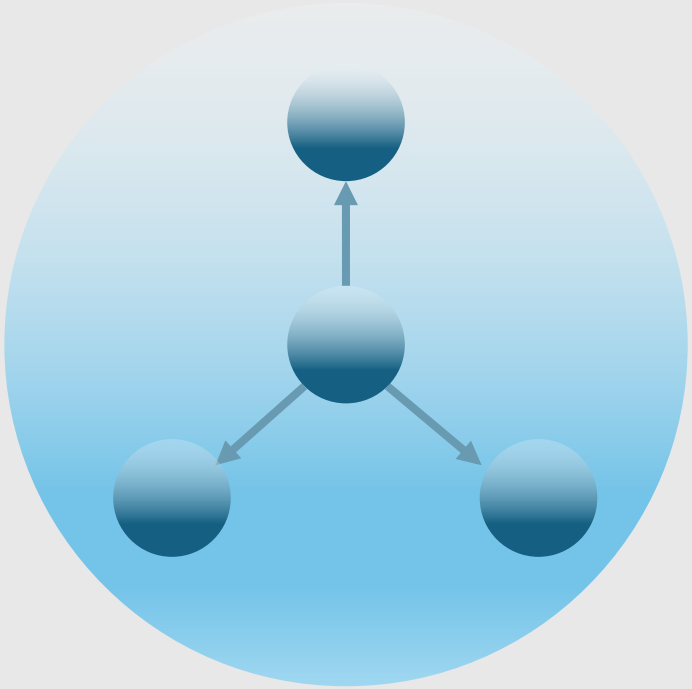
What are ‘things’?



Anything you can think of or imagine:

- substances (e.g., water)
- objects (e.g., people)
- collections of objects (e.g., populations)
- parts of objects (e.g., legs)
- attributes of objects (e.g., height)
- processes (e.g., birth)
- time (e.g., dates)
- information (e.g., instructions)

How are things represented?

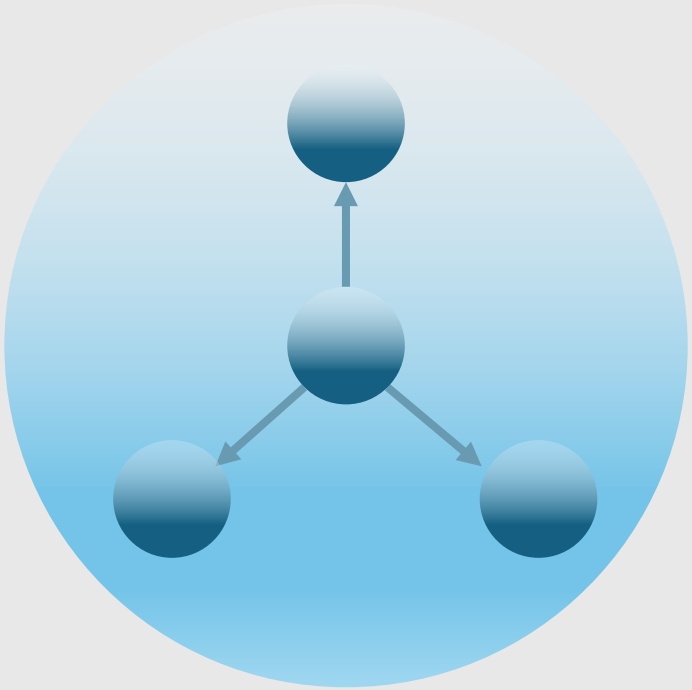


Things (aka ‘entities’) are instances of ‘classes’ that have ‘properties’

Classes are groups of things that share properties. They are defined by the properties that they share.

Properties are **relations** between things and between classes of things.

Example



Robert West is an instance of the class ‘human being’

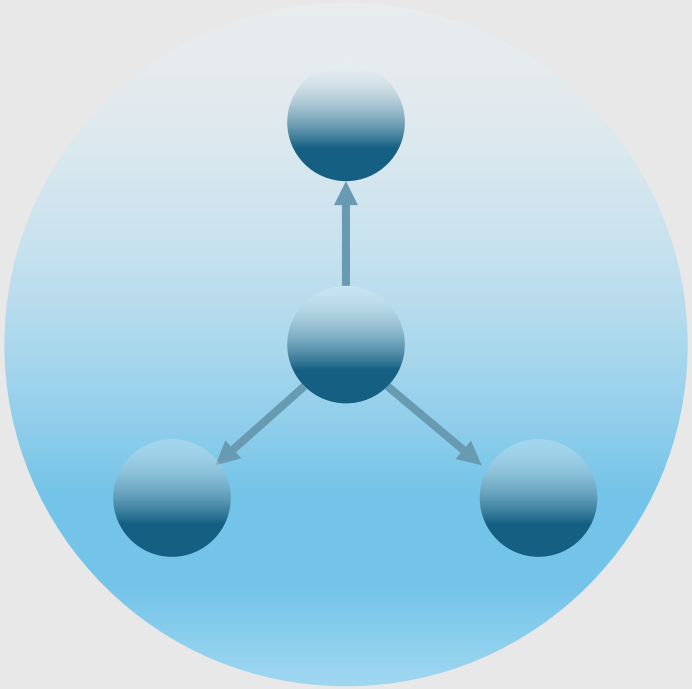
He has the following properties:

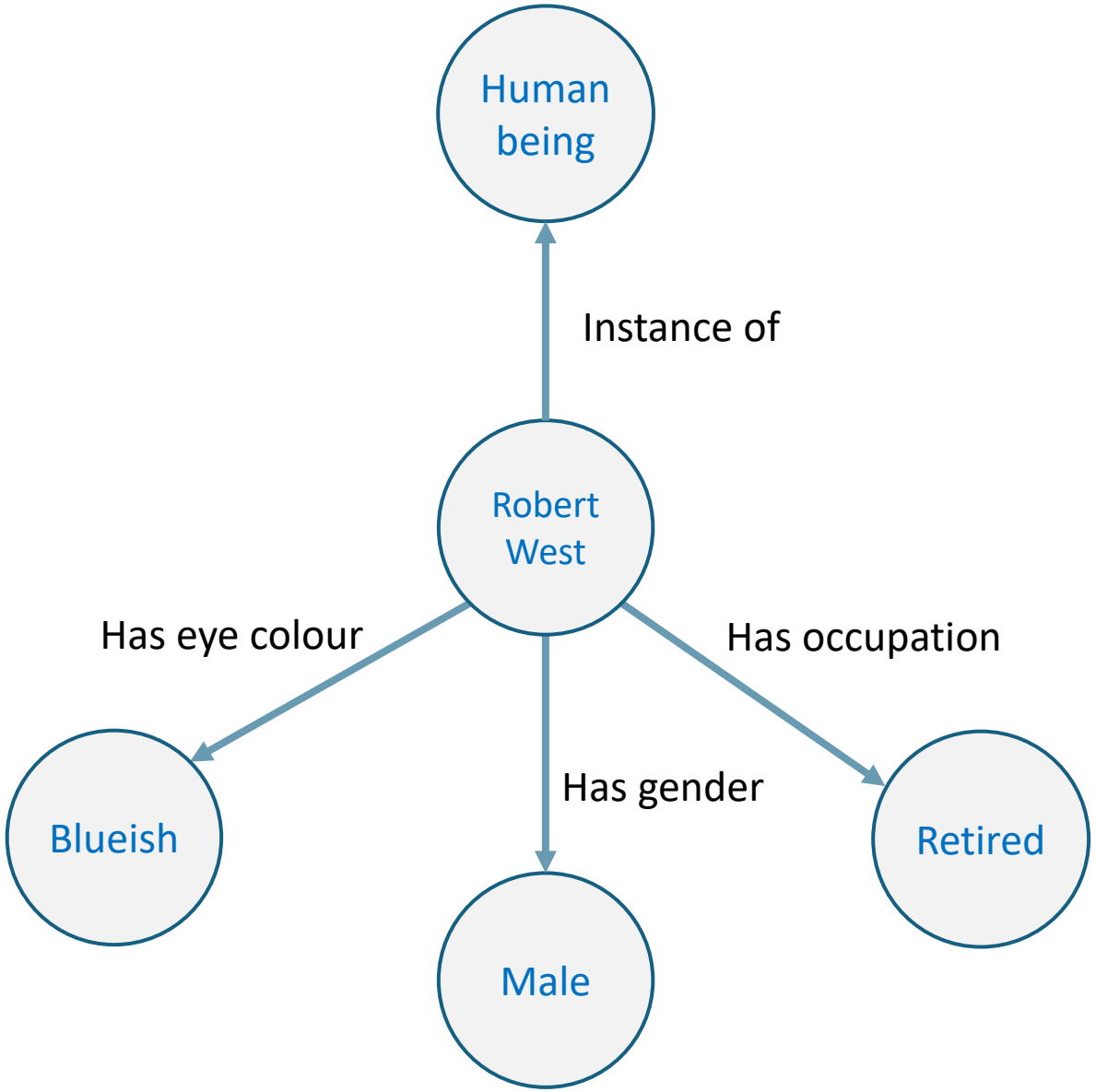
has gender	male
has occupation	retired
has eye colour	blue(ish)

Relation

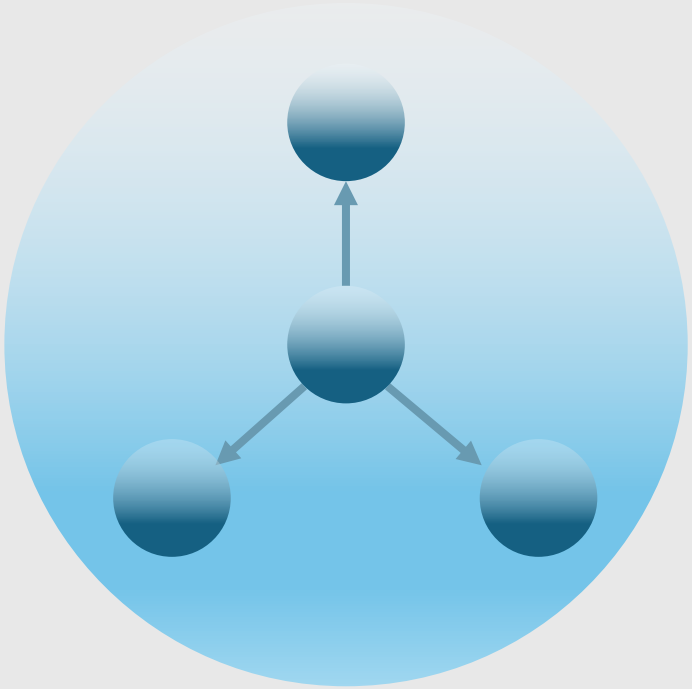
Another class

Example




Human being
Instance of
Robert West
Has eye colour
Has occupation
Has gender
Blueish
Male
Retired

Defining classes

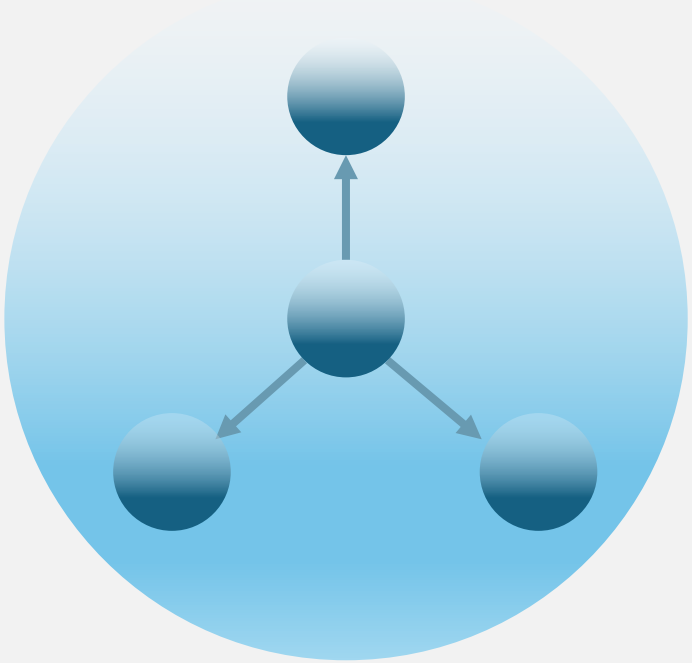


Ontology classes are best defined in terms of their **‘parent class’** and **‘differentia’** that distinguish them from their sibling classes.

Parent classes are classes that are immediately above them in a semantic hierarchy.

Sibling classes are classes that share the same parent class.

Example



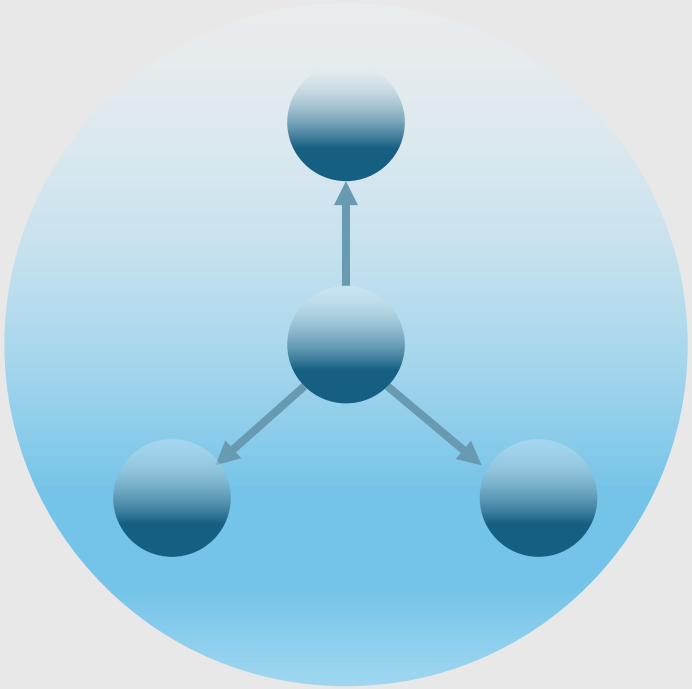
Label: ‘Individual human behaviour’

Definition: A bodily process of a human that involves co-ordinated contraction of striated muscles controlled by the brain.

Parent: ‘bodily process’

Differentia: ‘... of a human that involves co-ordinated contraction of striated muscles controlled by the brain’

Referring to classes



*Formerly URIs: Uniform Resource Identifiers

Every class has a **unique ID** so that it can be easily referred to without ambiguity.

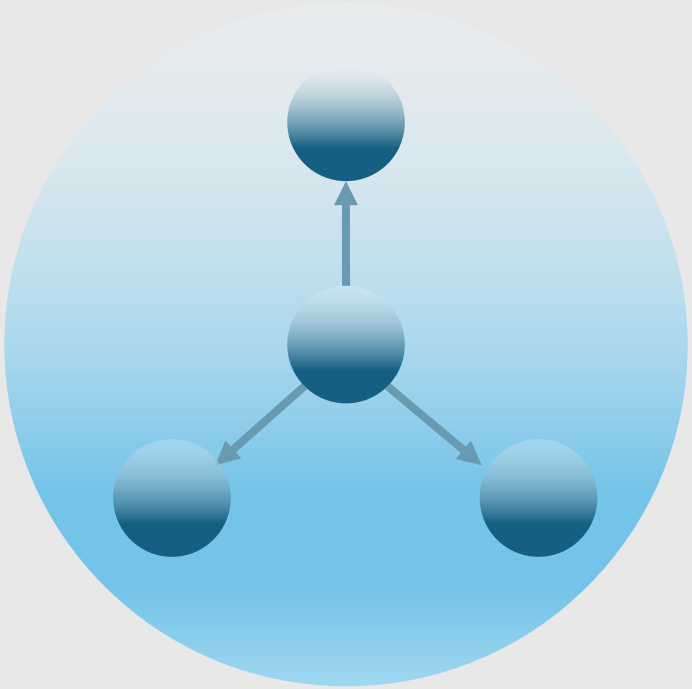
IDs usually take the form of **IRIs*** (Internationalized Resource Identifiers) that consist of a:

Namespace signifying the ontology that it belongs to, and

Number uniquely identifying it in that ontology

E.g., BCIO:036000

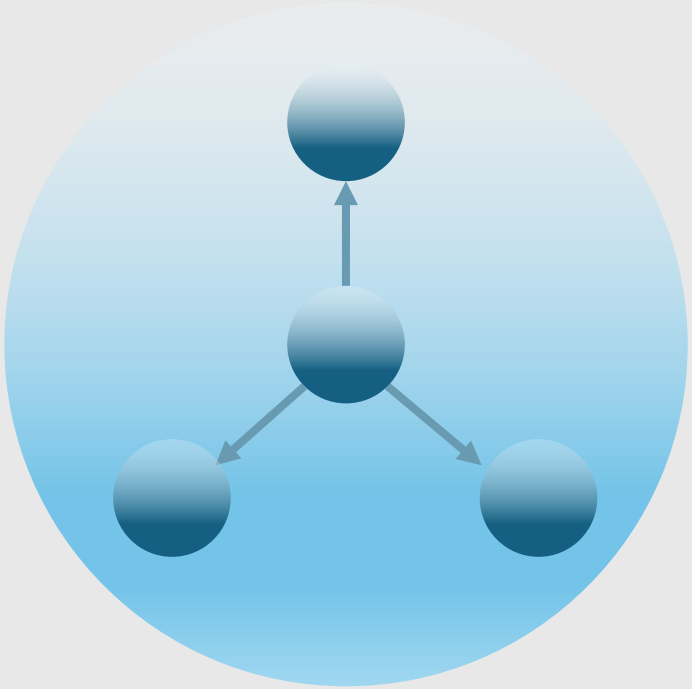
What is a ‘namespace’?



A unique identifier for an ontology

Ontology name	Namespace
Behaviour Change Intervention Ontology	BCIO:
Addiction Ontology	AddictO:
Gene Ontology	GO:

Labelling classes

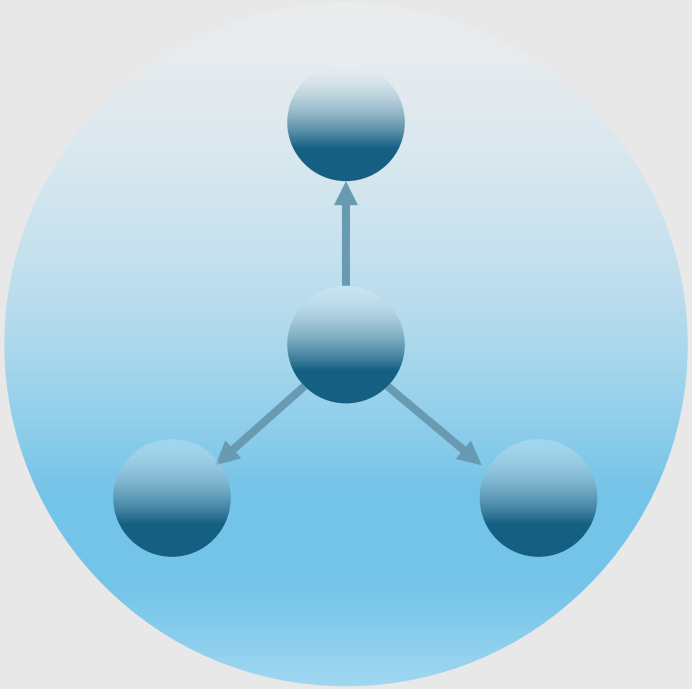


Ontology classes also have **labels** that helps humans to refer to them and use them in documents.

Labels are unique within a given ontology, but different ontologies may attach a label to different definitions.

Ideally, labels should be specific enough to avoid confusion with labels from other ontologies.

Ontologies versus dictionaries



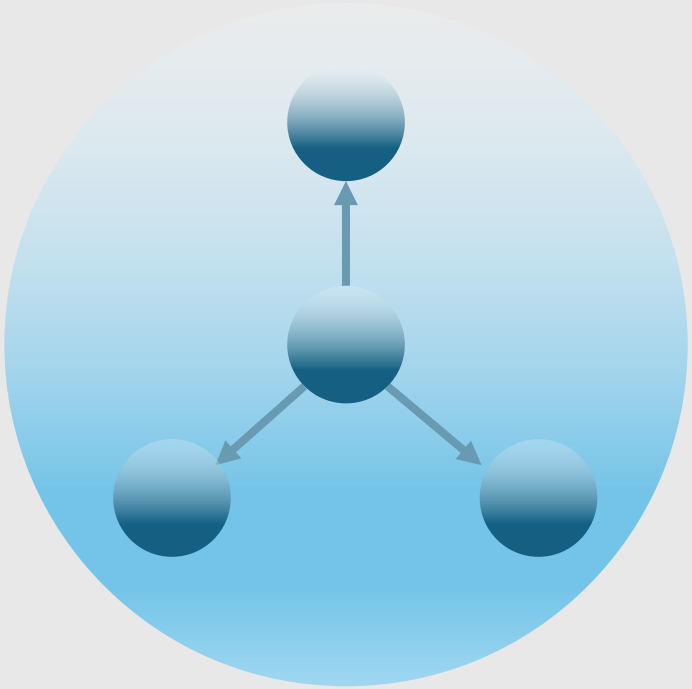
Ontologies are not dictionaries.

Dictionaries tell us the agreed meanings of words.

Ontologies allow us to refer to uniquely defined classes using IRIs. The labels are ways to remember what those classes are.

Ontologies do not tell us the ‘correct’ or ‘true’ meaning of terms. They offer us clearly defined classes and ways of referring to them.

Finding classes on the internet

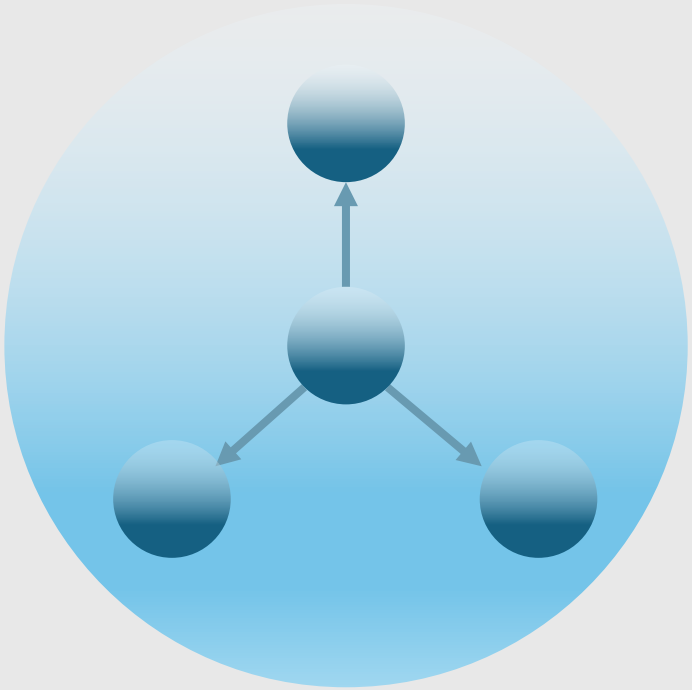


Ontology classes used in science should be accessible directly from the web using **URLs (Uniform Resources Locators)**.

URLs are unique internet addresses that point directly to a web page.

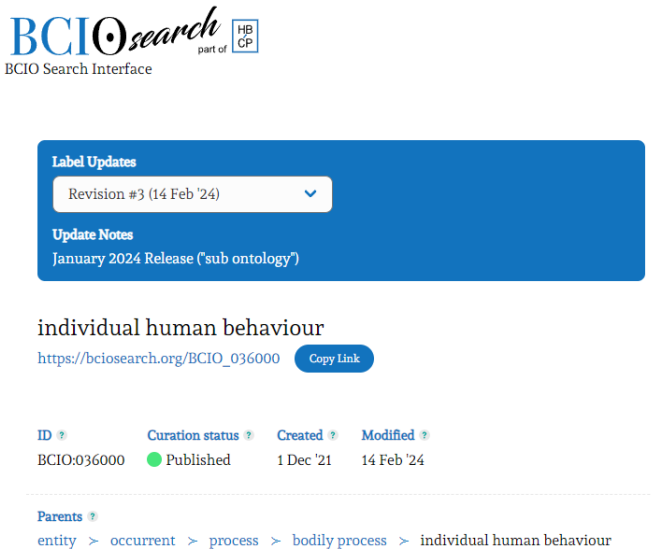
Each ontology class should have a web page.

Example

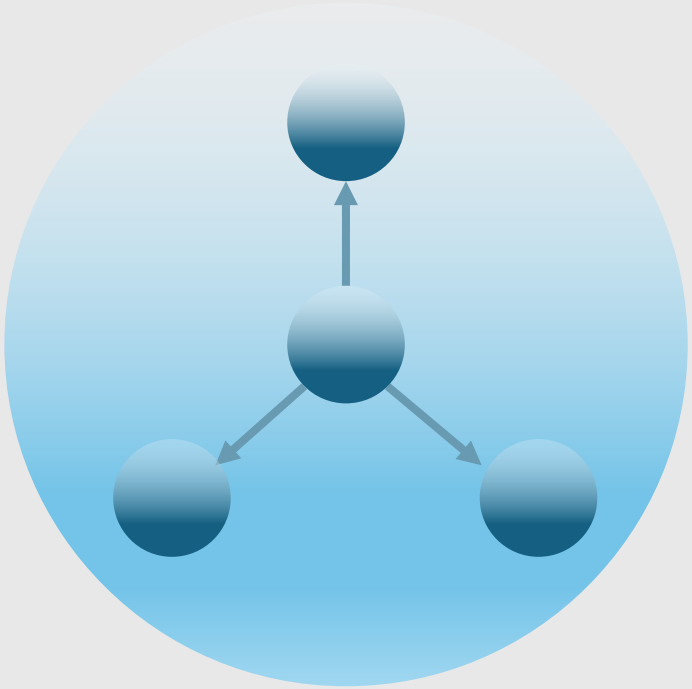


ONLINE DEMO

Label: Individual human behaviour
IRI: BCIO:036000
URL: https://www.bciosearch.org/BCIO_036000
Definition: A bodily process of a human that involves co-ordinated contraction of striated muscles controlled by the brain.



The semantic hierarchy



Every class should have a parent class which tells users what kind of a thing it is.

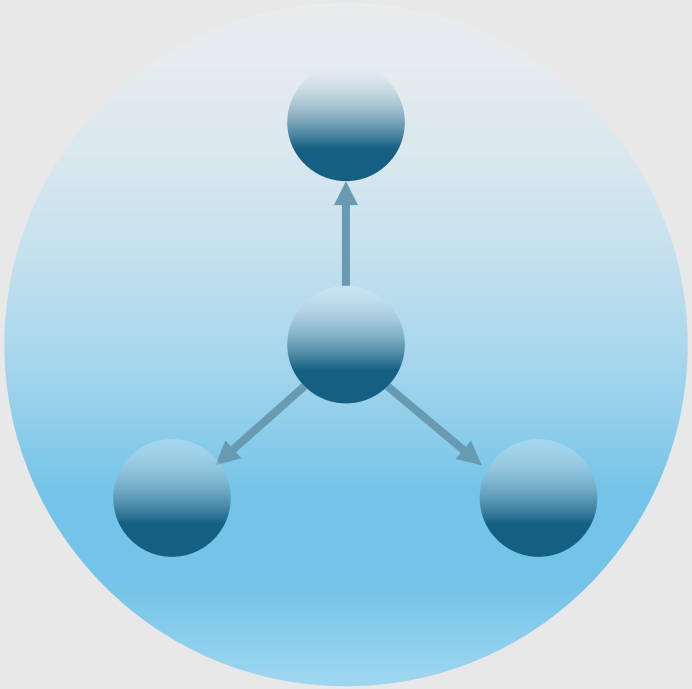
Classes inherit ALL the properties of their parent class.

This is what creates **coherence** in ontologies. Classes are related to each other in ways that make sense to users and allow users to find them and make reasonable inferences from them.

The semantic hierarchy is therefore extremely important.

Ontologies that are used in a given project should have compatible semantic hierarchies.

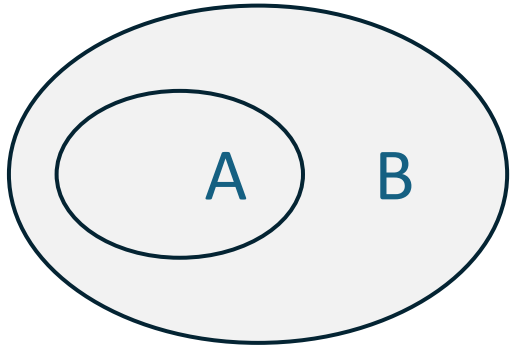
‘Is_a’ and ‘subclass’ relations



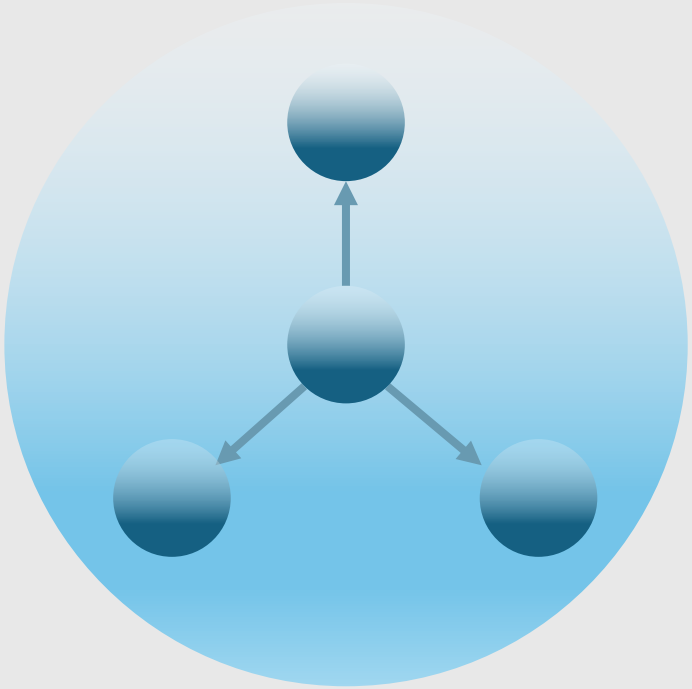
The semantic hierarchy is created by the ‘**is_a**’ also known as the ‘**subClassOf**’ relation.

A is_a B	A has ALL the properties of B but B does not have all the properties of A

In this case B is often called the ‘parent class’ of A ,and A is the ‘child class’ of B



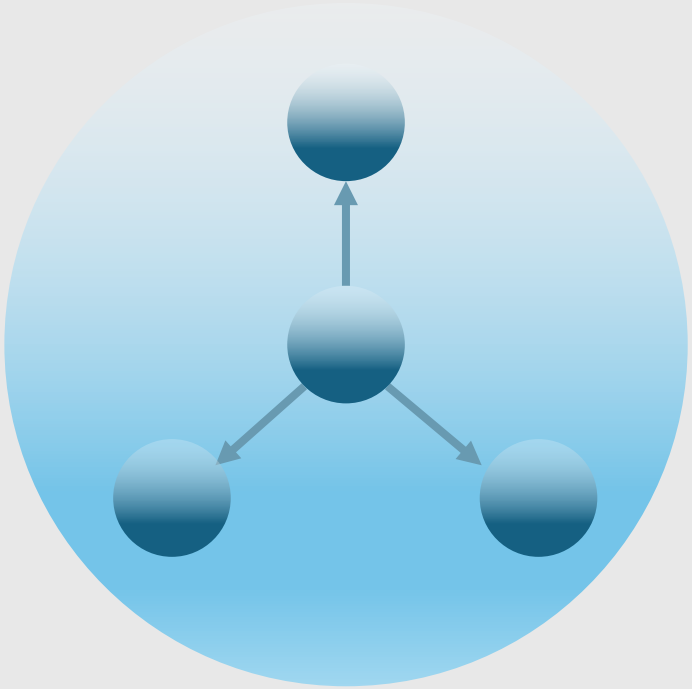
Example



ONLINE DEMO

- entity BFO (1,252)
  - occurrent BFO (811)
    - process BFO (793)
      - bodily process OGMS (240)
        - individual human behaviour (130)
          - experience-related behaviour (9)
          - expressive behaviour (15)
          - habitual behaviour
          - harmful behaviour (4)
          - health-related behaviour (31)
          - inter-personal behaviour (4)
          - laughing
          - life function-related behaviour (3)
          - material entity-related behaviour (28)
          - normative behaviour
          - personal bodily care behaviour (6)
          - position-related behaviour (10)
          - socially-related behaviour (13)

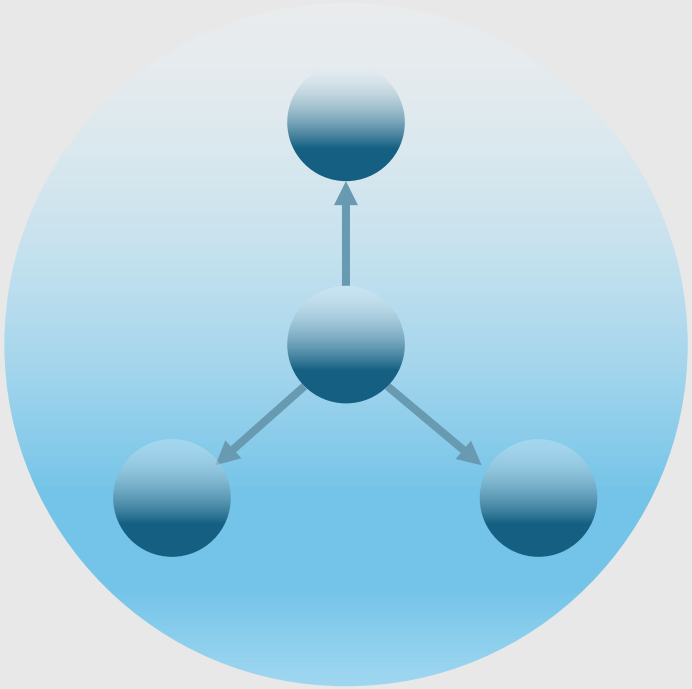
Questions and discussion



ARE YOU CLEAR ABOUT …

1. What are ‘classes’ in ontologies?
2. What are ‘properties’?
3. What does the ‘is_a’ relation signify?
4. What feature of ontologies confers coherence?

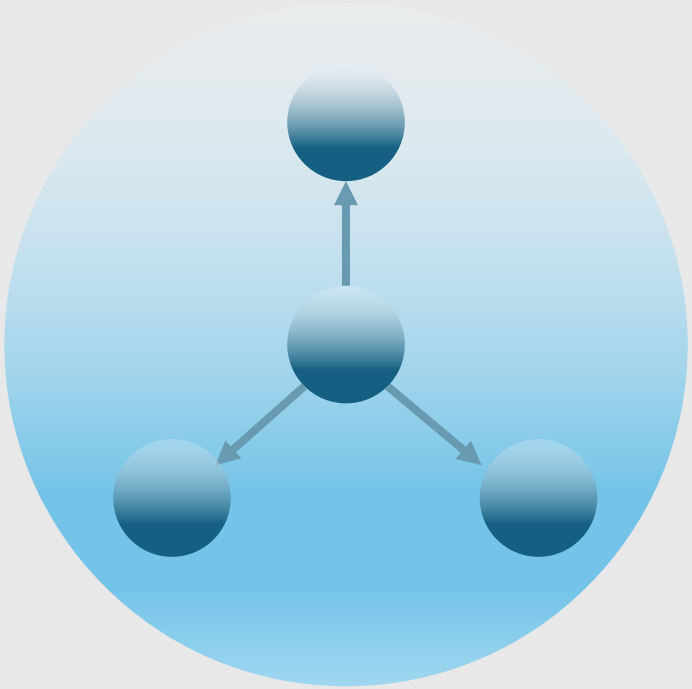
The top of the semantic hierarchy: BFO



Basic Formal Ontology (BFO) is the most widely used ontology of upper-level classes for use in other ontologies in biosciences.

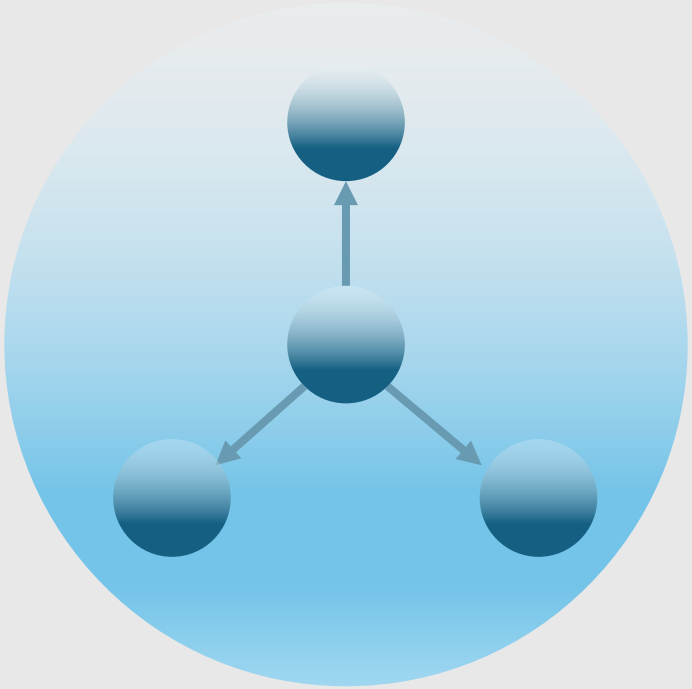
It provides a unifying semantic structure for all these ontologies, which trace a path up to one of its classes.

Basic Formal Ontology



- entity
  - continuant
    - generically dependent continuant
    - independent continuant
      - immaterial entity
        - continuant fiat boundary
        - site
        - spatial region
      - material entity
        - fiat object part
        - object
        - object aggregate
    - specifically dependent continuant
      - quality
        - relational quality
      - realizable entity
        - disposition
          - function
        - role
  - occurrent
    - process
      - history
      - process profile
    - process boundary
    - spatiotemporal region
    - temporal region

BFO: Commonly used classes



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    - temporal region

a material entity that exists as a connected whole

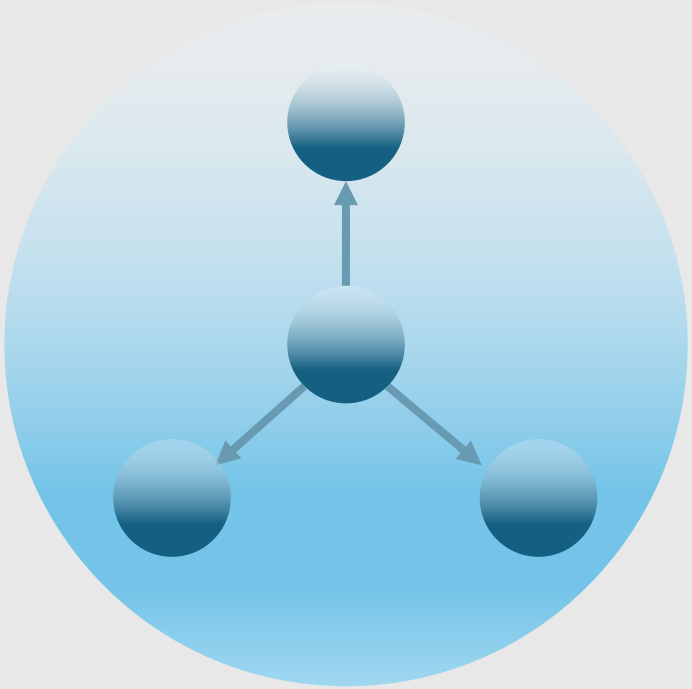
a material entity that is two or more objects

an attribute of something that is always true

an attribute of something that results in things happening under certain conditions

something that takes place over time

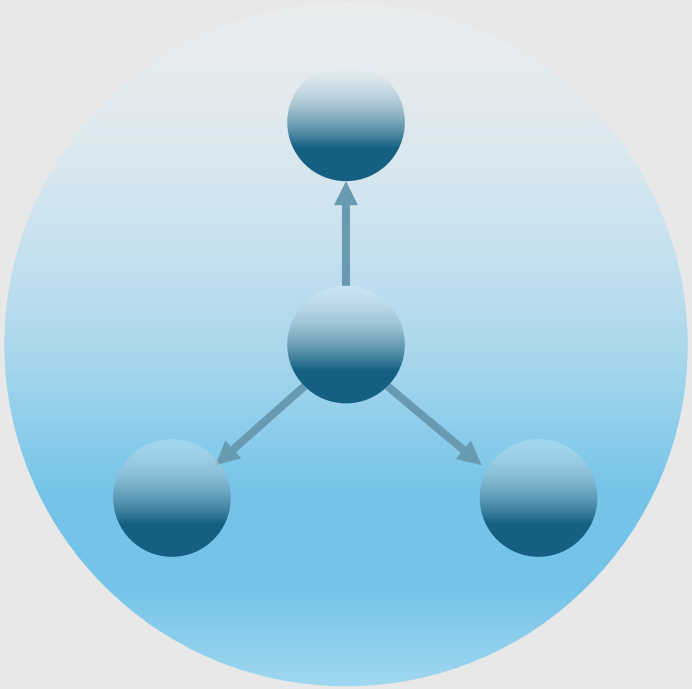
Questions and discussion



ARE YOU CLEAR ABOUT …

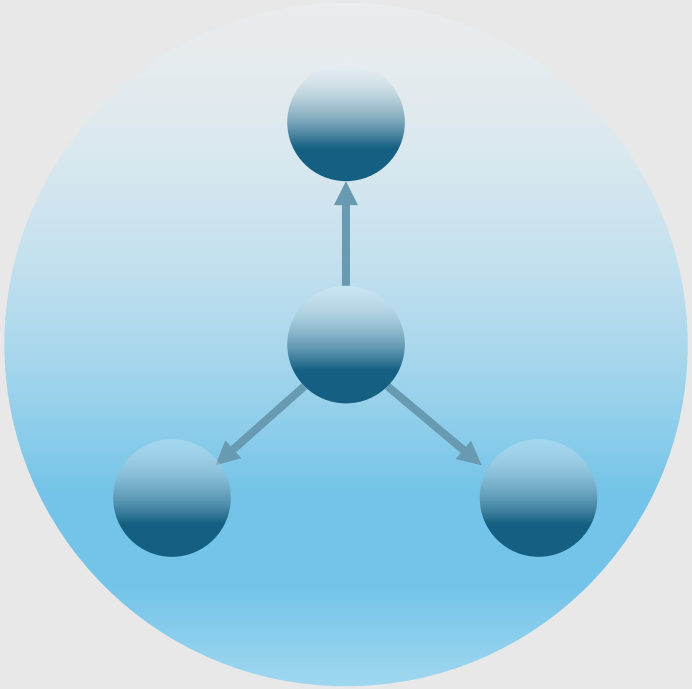
1. Why should we want ontologies to use a common upper-level ontology?
2. In BFO what is the difference between an ‘occurrent’ and a ‘continuant’?

What ontologies provide



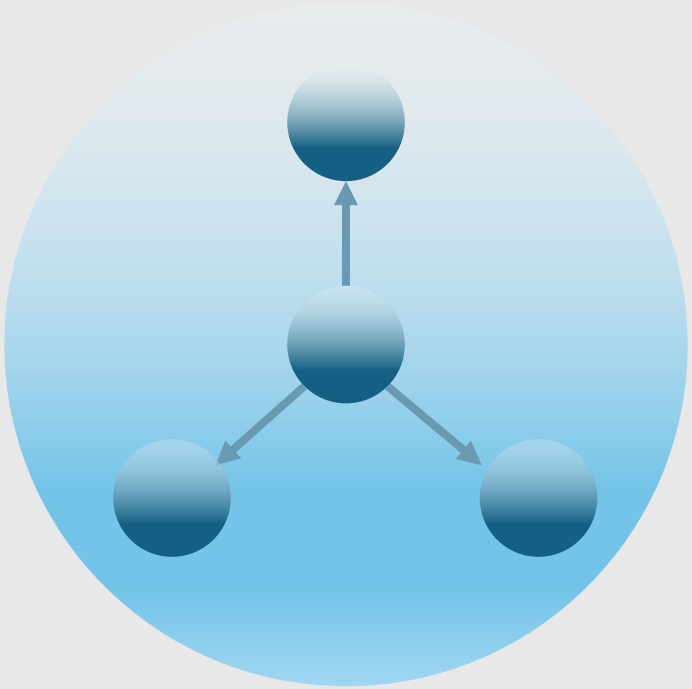
Clarity	Classes are defined according to their properties
Consistency	Classes are referred to using unique IDs
Coherence	Classes and organised into a well-specified semantic hierarchy
Connectedness	Ability to connect data, models and evidence within and across domains

Activities that ontologies support



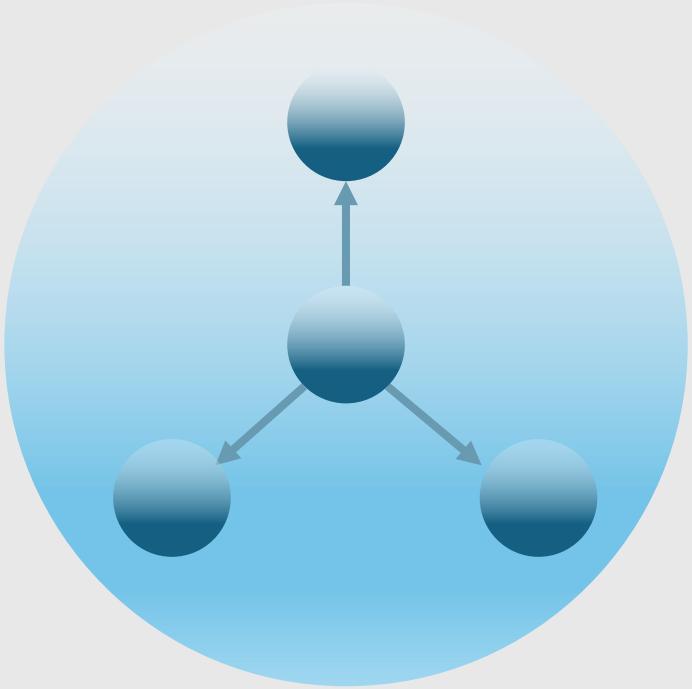
1. Knowledge organization
2. Data integration
3. Information search
4. Collaboration
5. Hypothesis generation and testing
6. Knowledge discovery and data mining
7. Science education and training
8. Scientific workflows and automation

How are ontologies used in science?



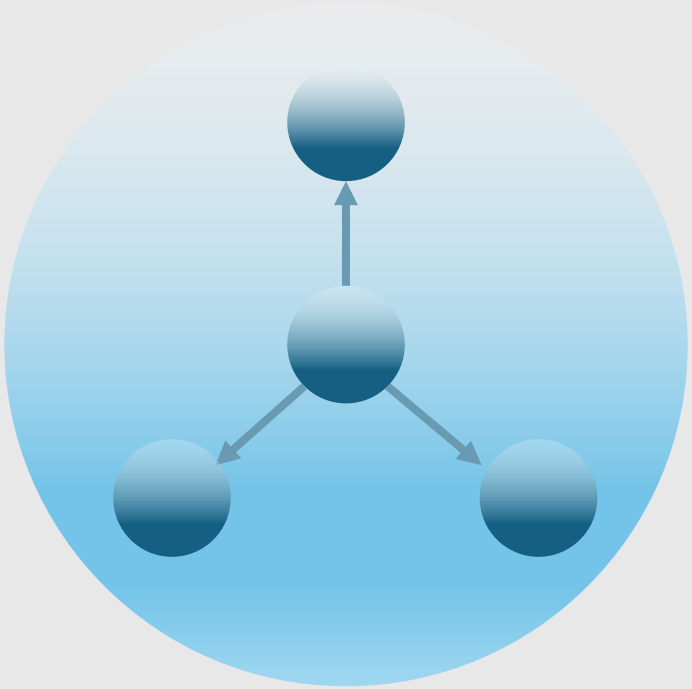
1. Designing interventions
2. Designing studies
3. Annotating data sets
4. Writing study reports
5. Annotating study reports
6. Searching for evidence
7. Building models

Questions and discussion



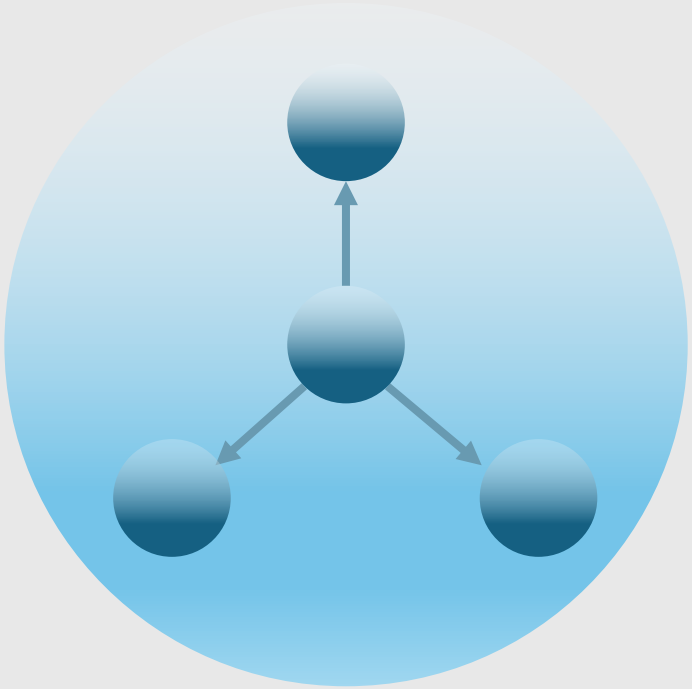
ARE YOU CLEAR ABOUT …

1. What uses might you have for ontologies?



What is the Behaviour Change Intervention Ontology (BCIO) and what does it cover?

What is the Behaviour Change Intervention Ontology (BCIO)?



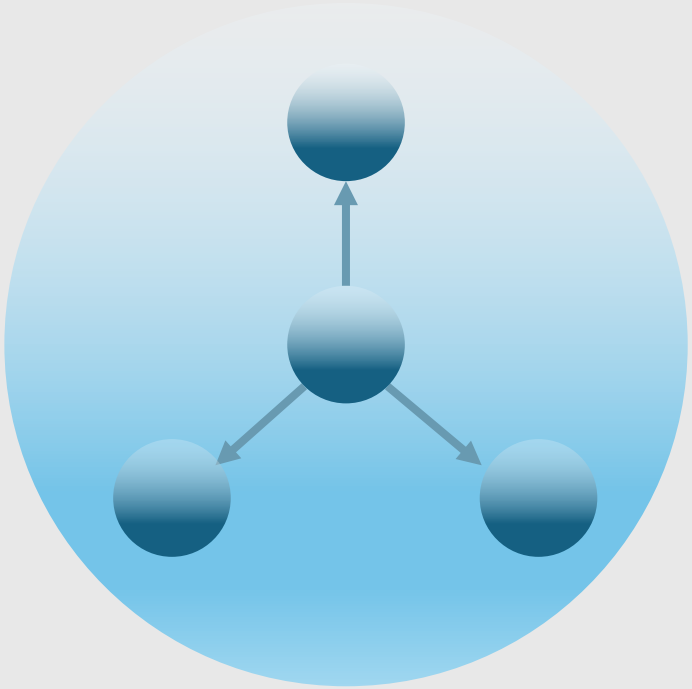
An ontology that can be used to describe behaviour change interventions and their evaluations

Uses Basic Formal Ontology as its upper level

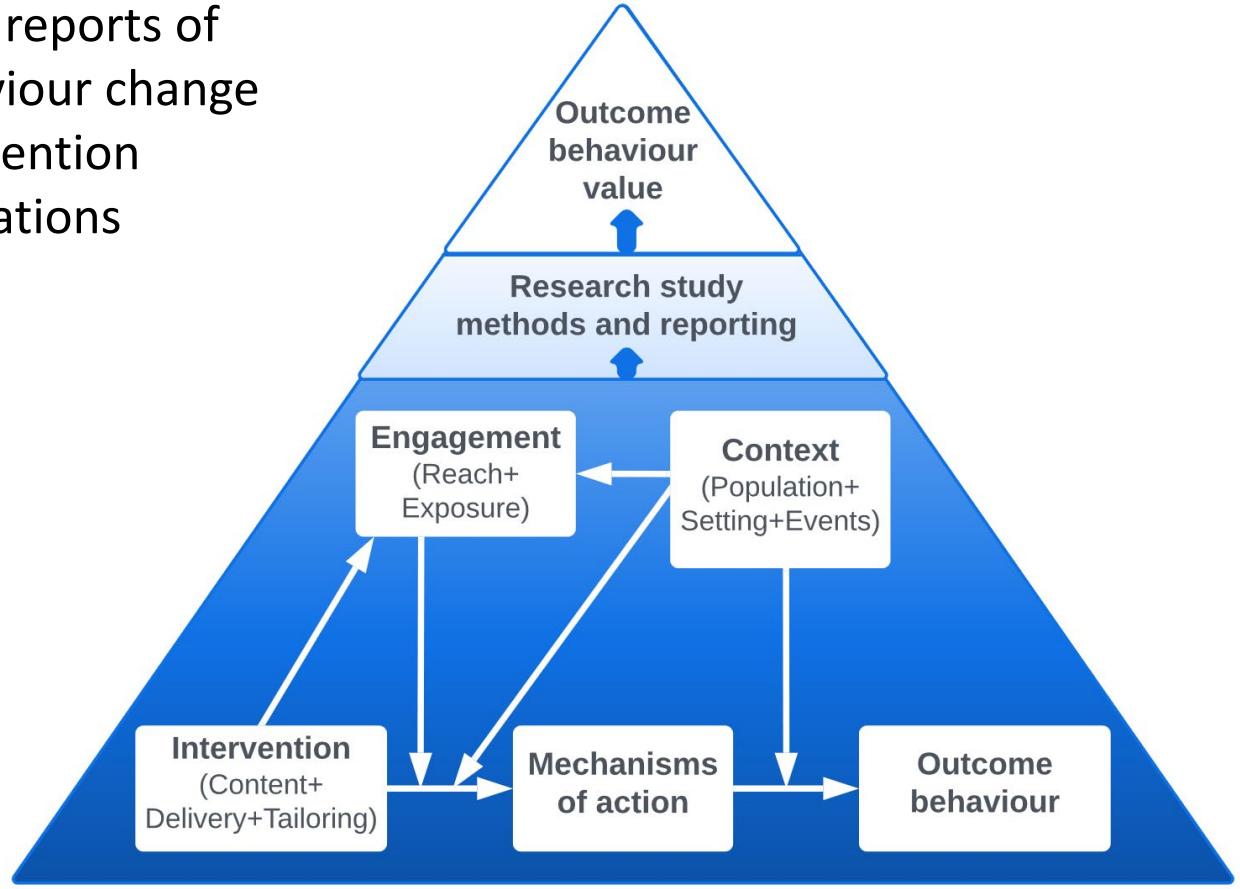
Fully aligned with:

- The Addiction Ontology (AddictO)
- The Mental Functioning Ontology (MF)
- The Emotion Ontology (MFOEM)

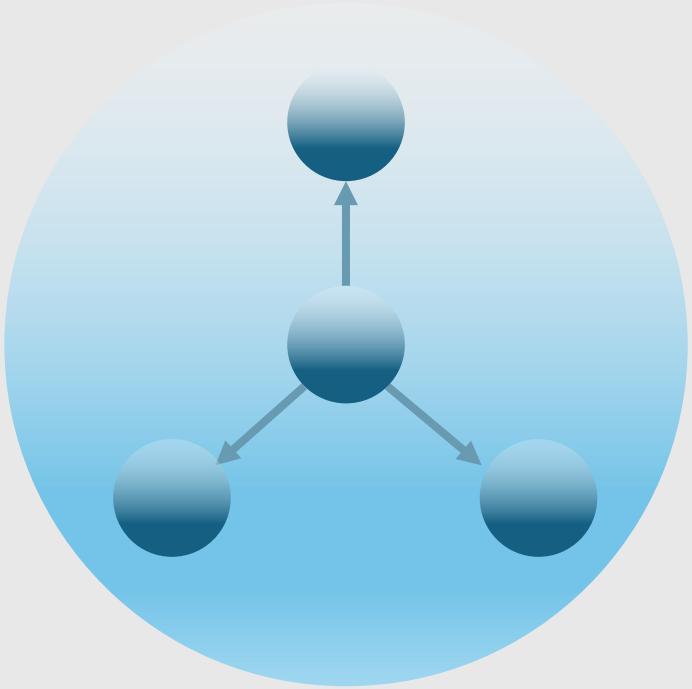
Scope of the BCIO



All the entities referred to in protocols and study reports of behaviour change intervention evaluations

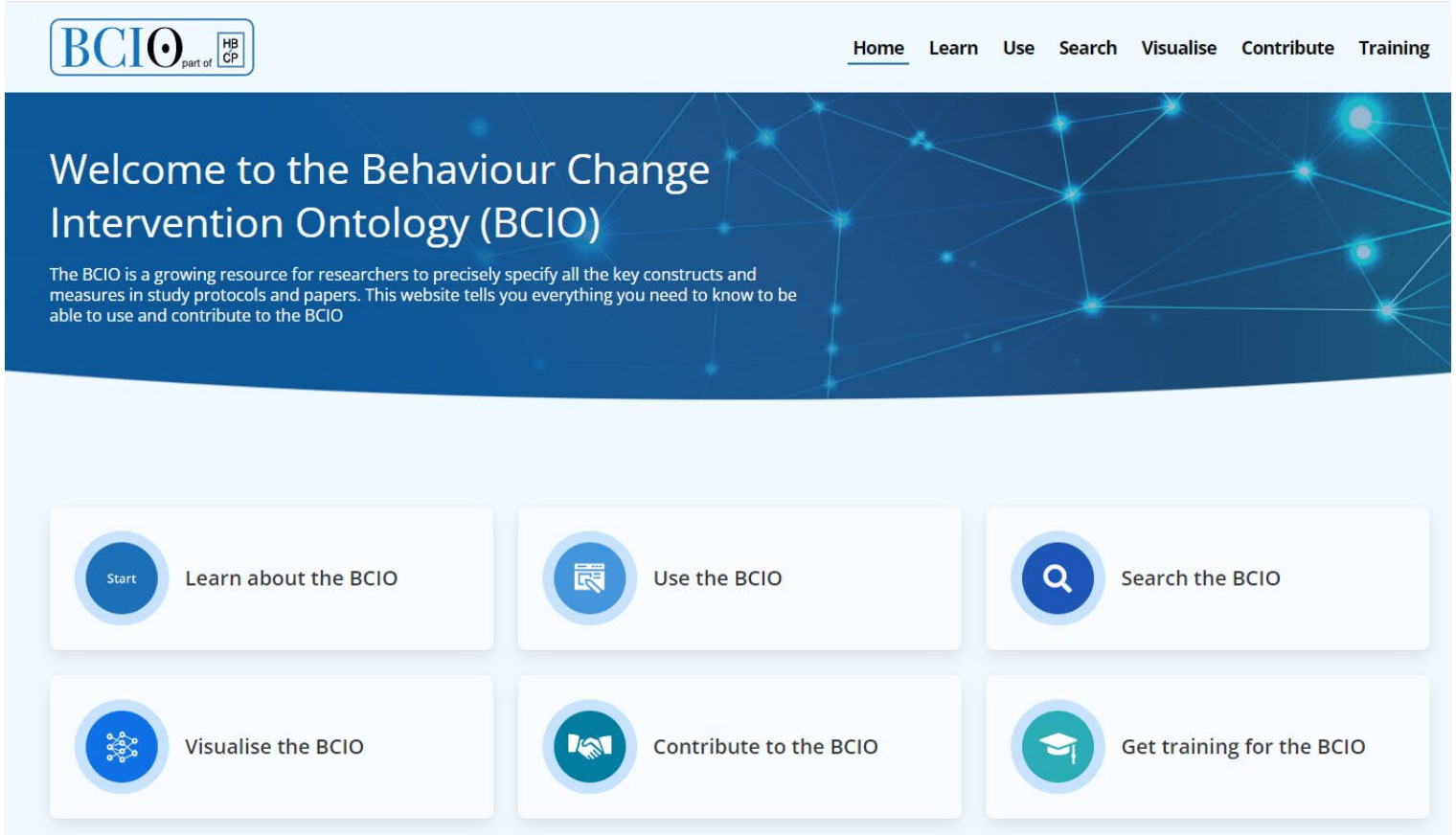


Learning about the BCIO

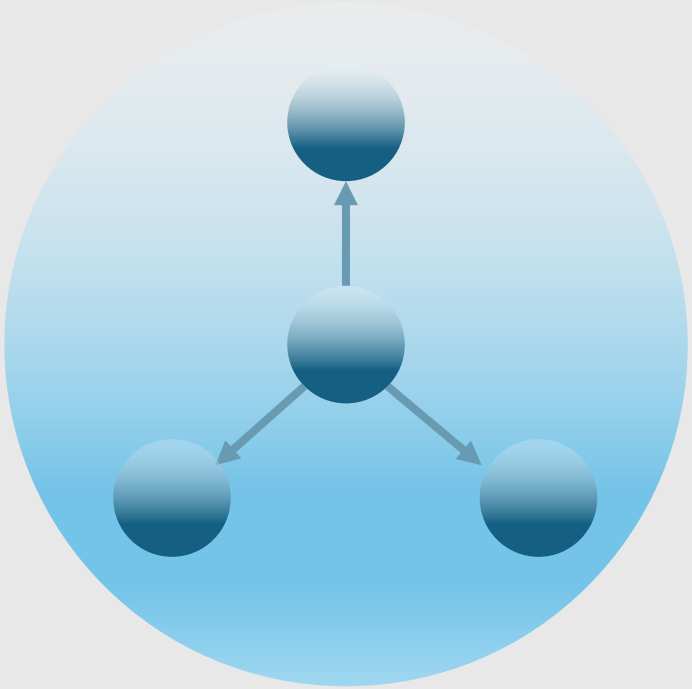


ONLINE DEMO

bciontology.org

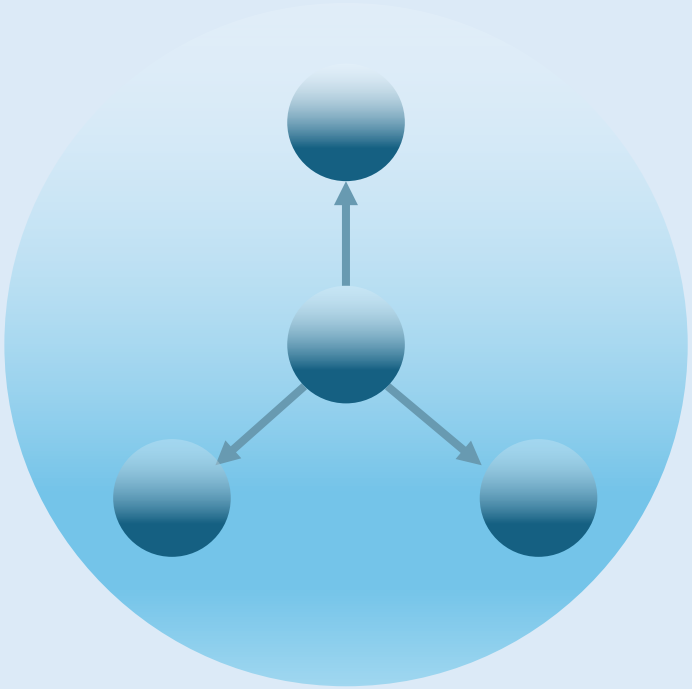


Questions and discussion



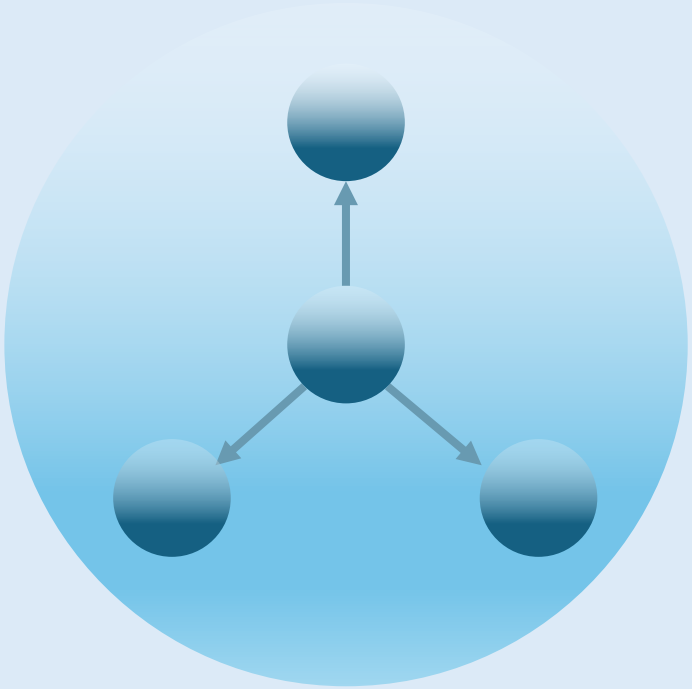
ARE YOU CLEAR ABOUT …

1. What is the scope of the BCIO?
2. What are the key components?
3. How to learn more about it?



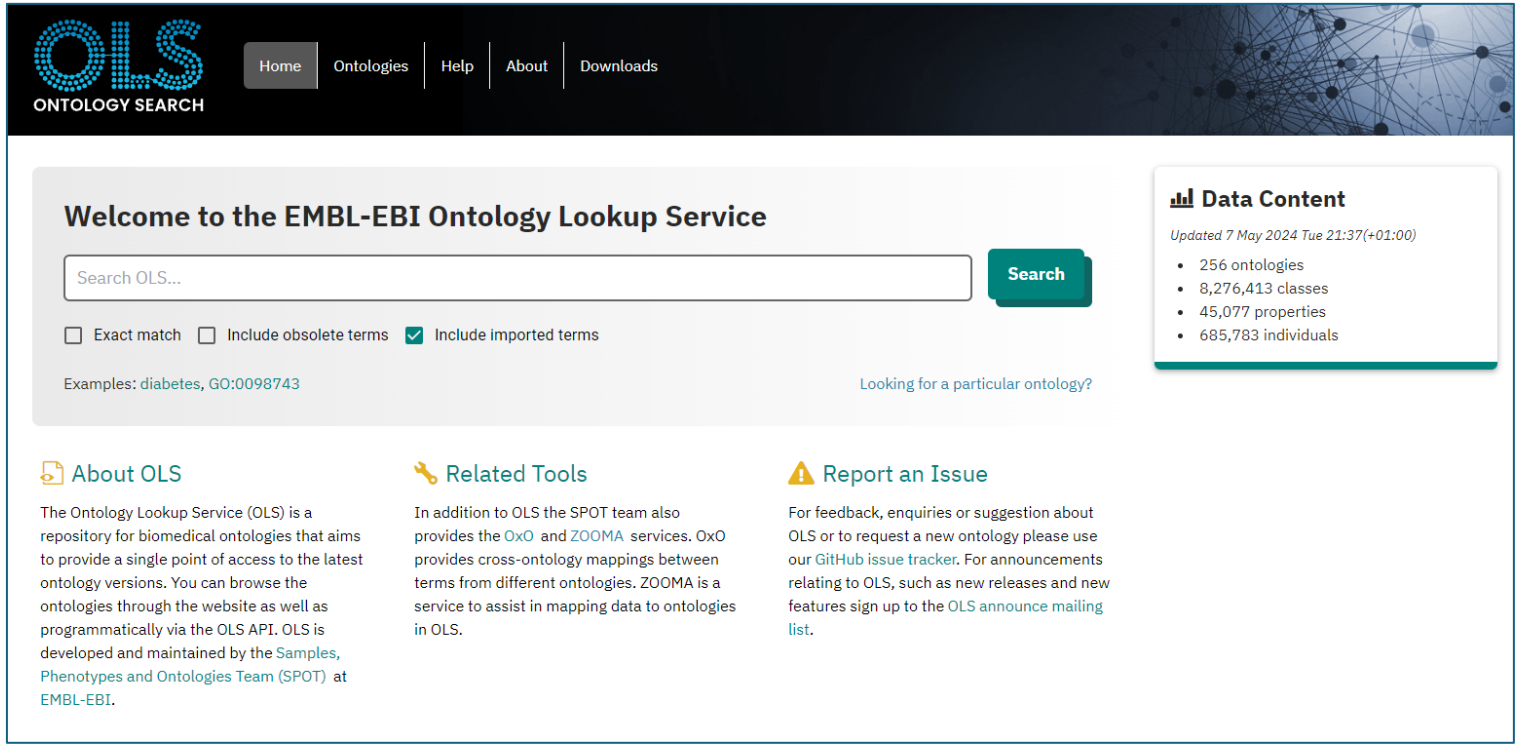
Finding ontology classes in the BCIO and related ontologies

Ontology Lookup Service

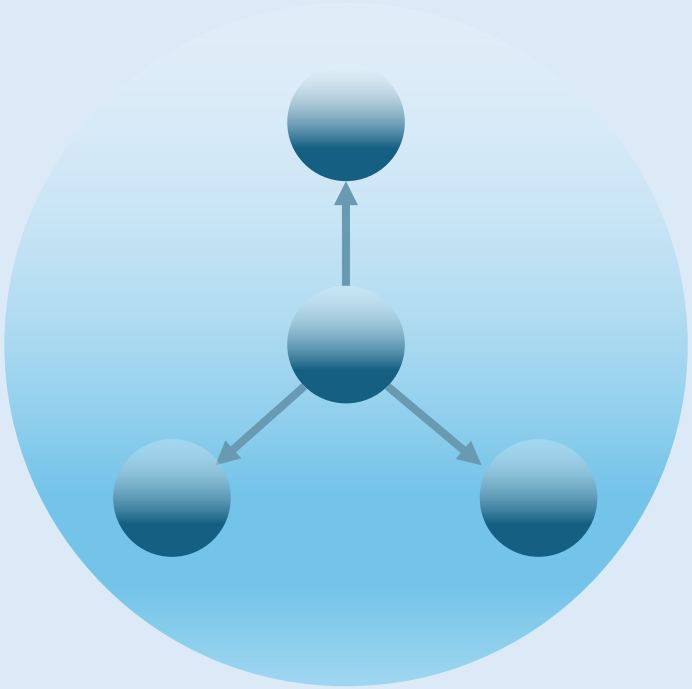


ONLINE DEMO

https://www.ebi.ac.uk/ols4

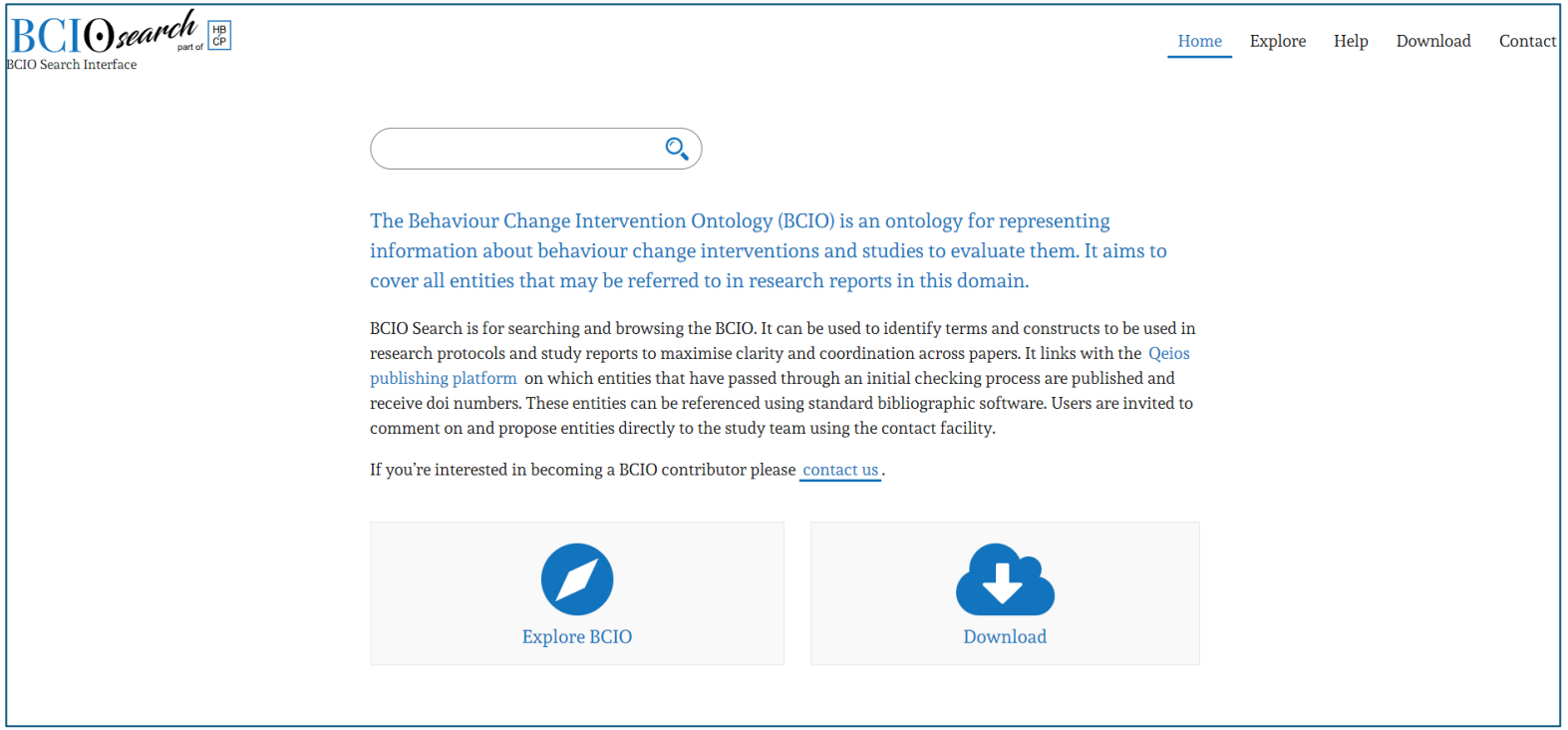


BCIO Search

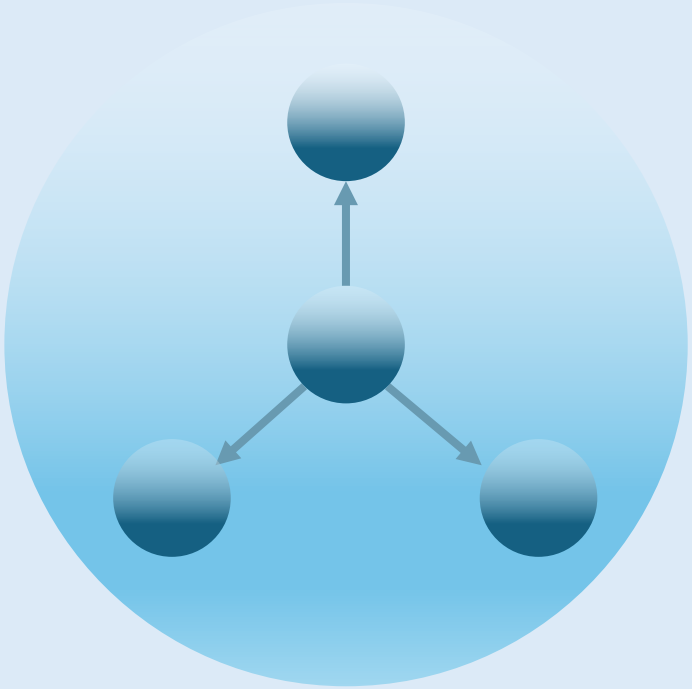


ONLINE DEMO

https://www.bciosearch.org/

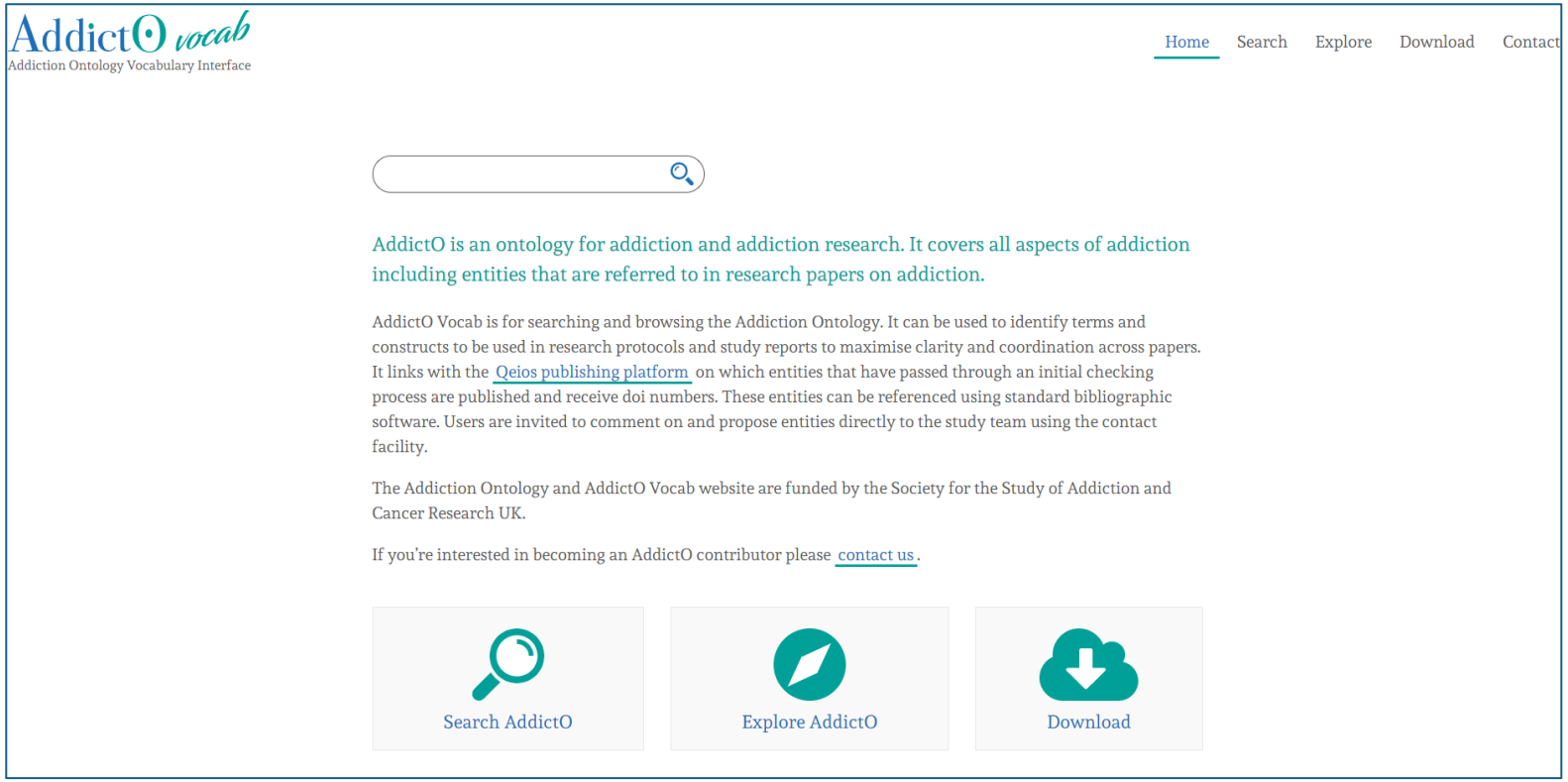


AddictO Vocab

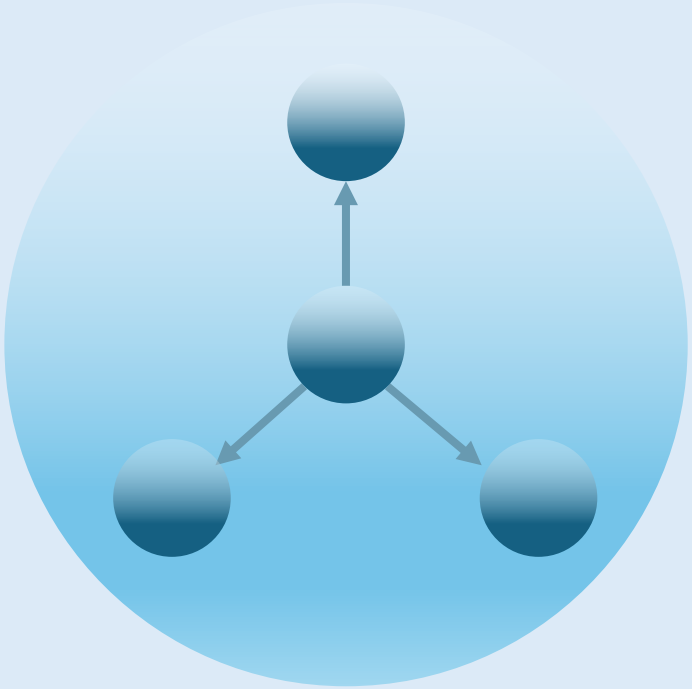


ONLINE DEMO

https://addictovocab.org/



BCIO Search



EXERCISE

See if you can find classes to characterise an intervention that has the following features:

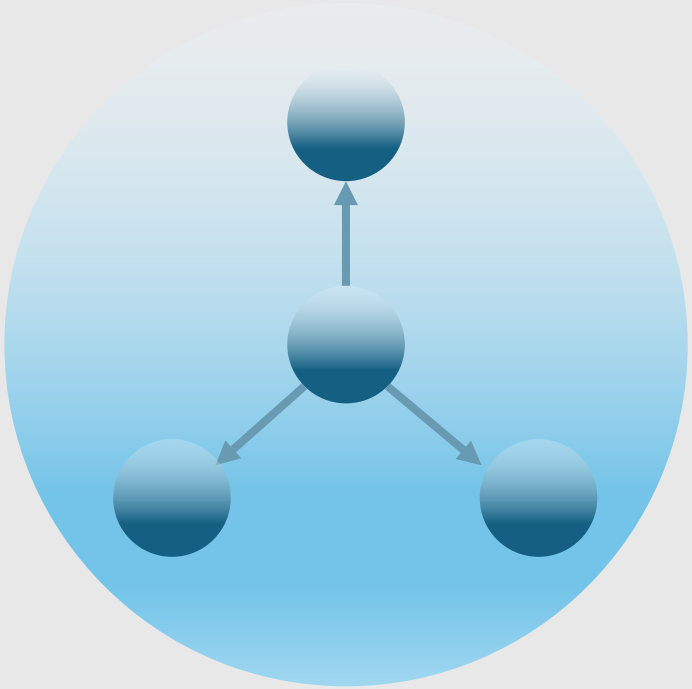
Content

- Setting a behavioural goal
- Advising on use of social support
- Promoting use of pharmacological support

Delivery

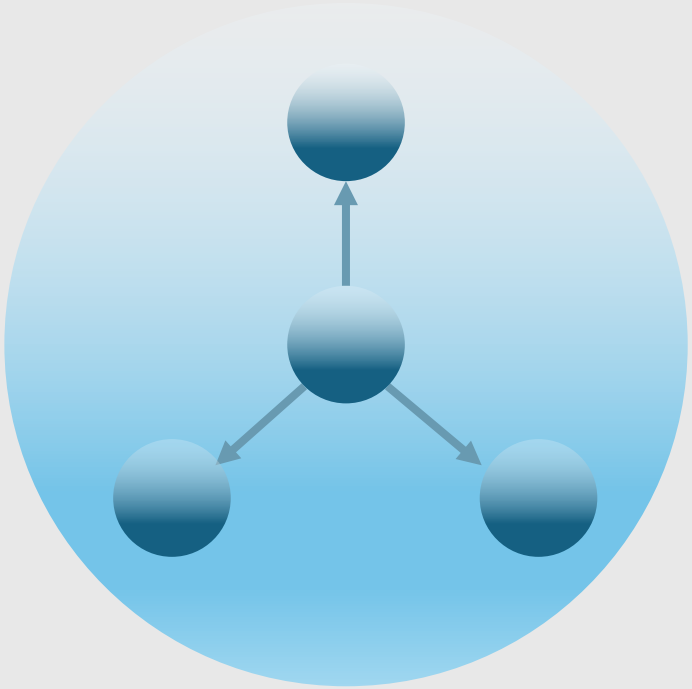
- Email mode of delivery
- Conversational communication style
- Person-centred delivery

Questions and discussion

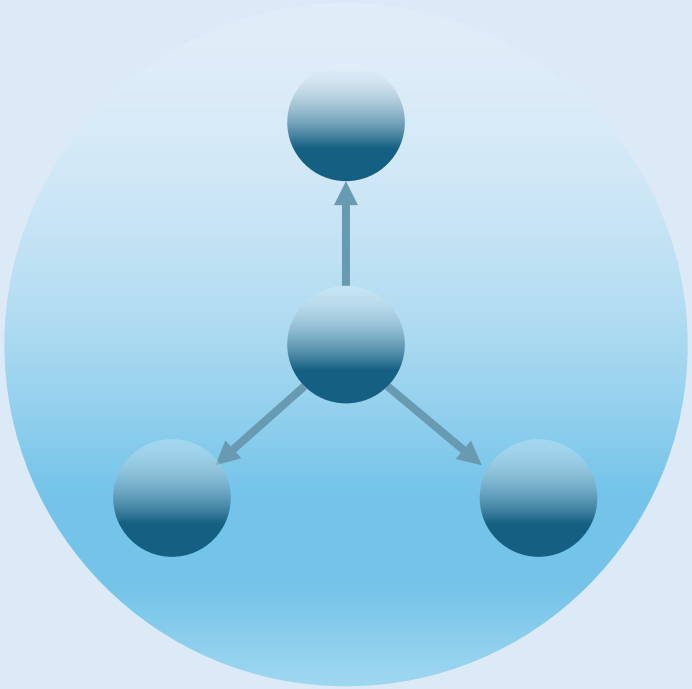


ARE YOU CLEAR ABOUT …

1. How to find classes in the BCIO?
2. What to do if a class you are looking for is not there?

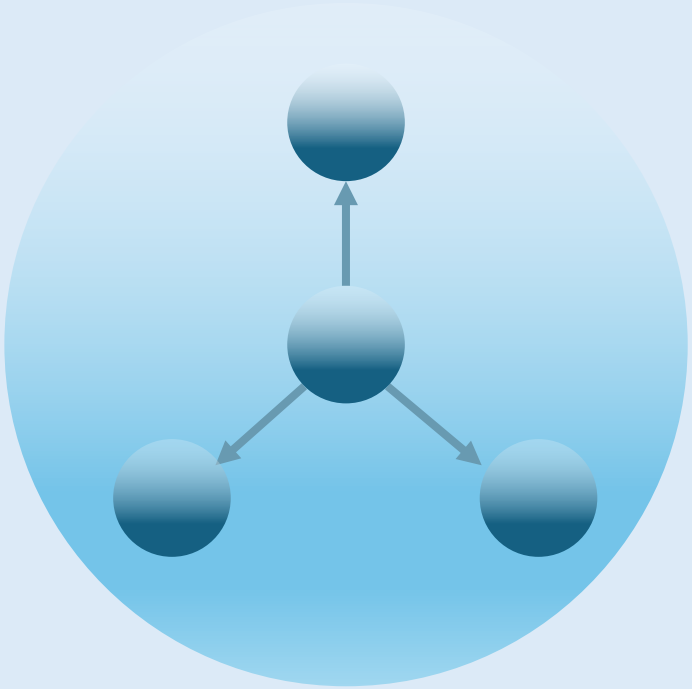


Break



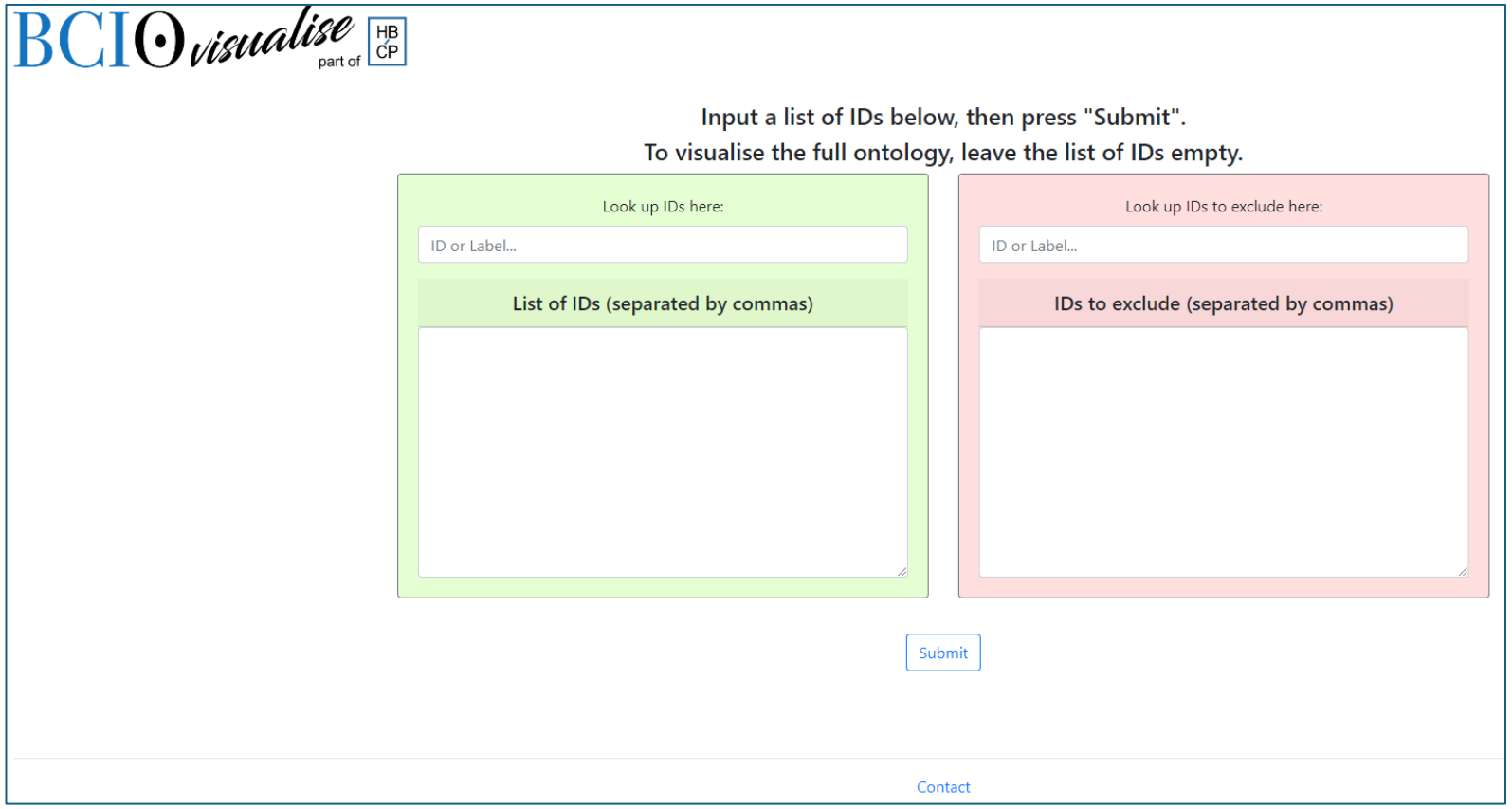
Seeing how ontology classes relate to each other

Visualising the ontology

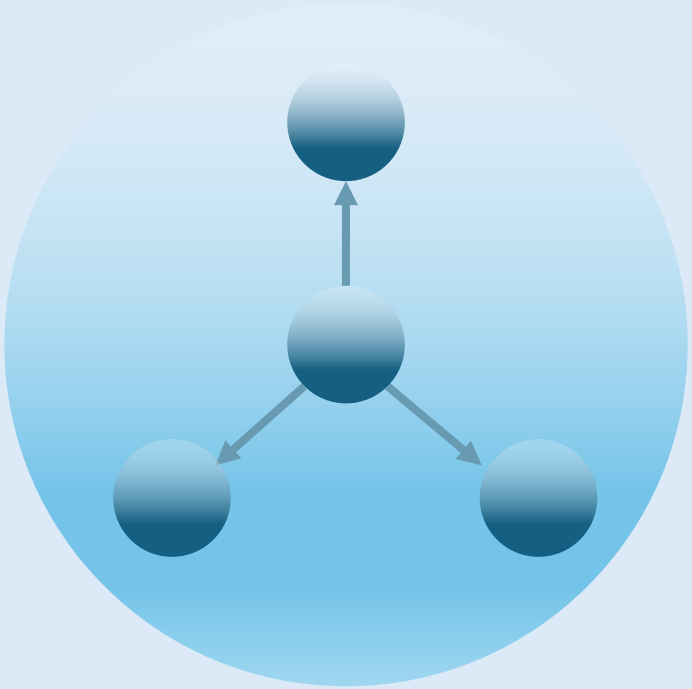


ONLINE DEMO

https://bciovis.hbcptools.org/



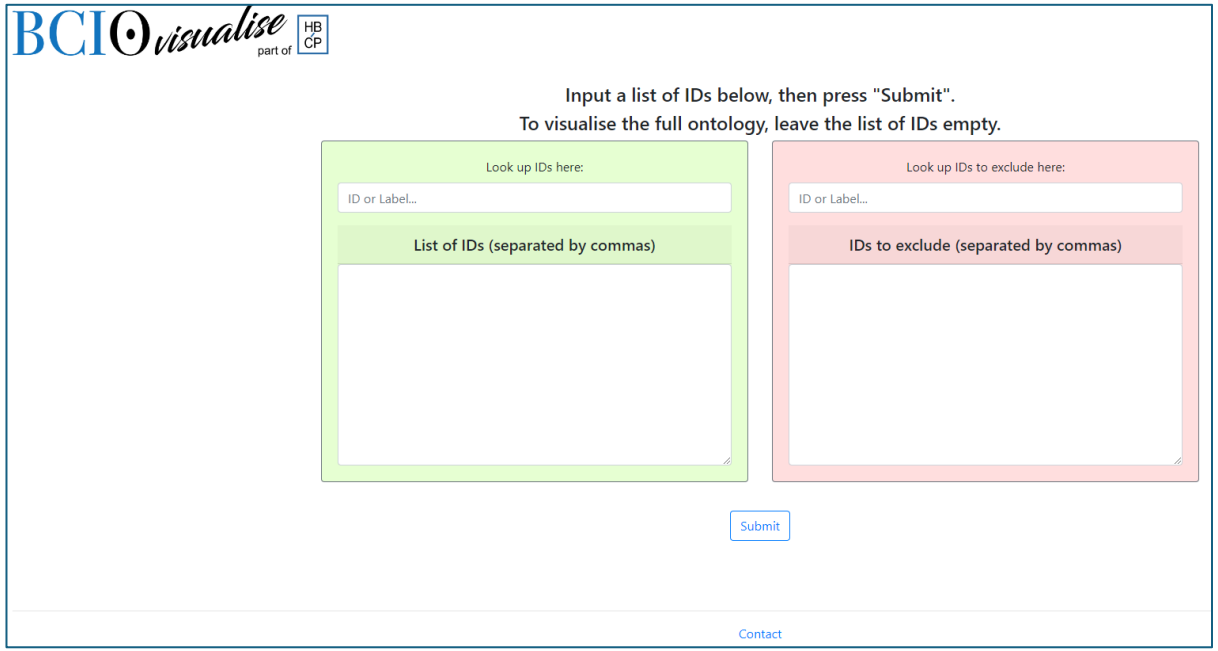
Visualising the ontology



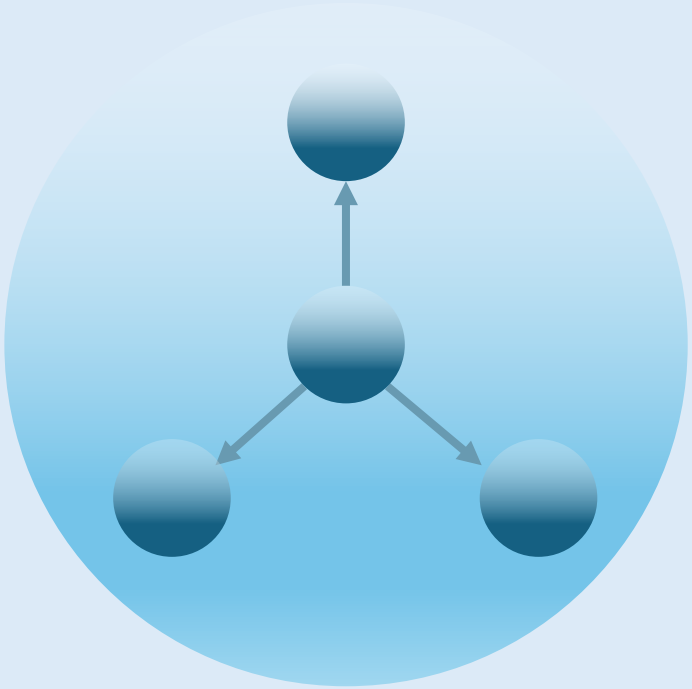
EXERCISE

https://bciovis.hbcptools.org/

Explore ‘behaviour change technique’

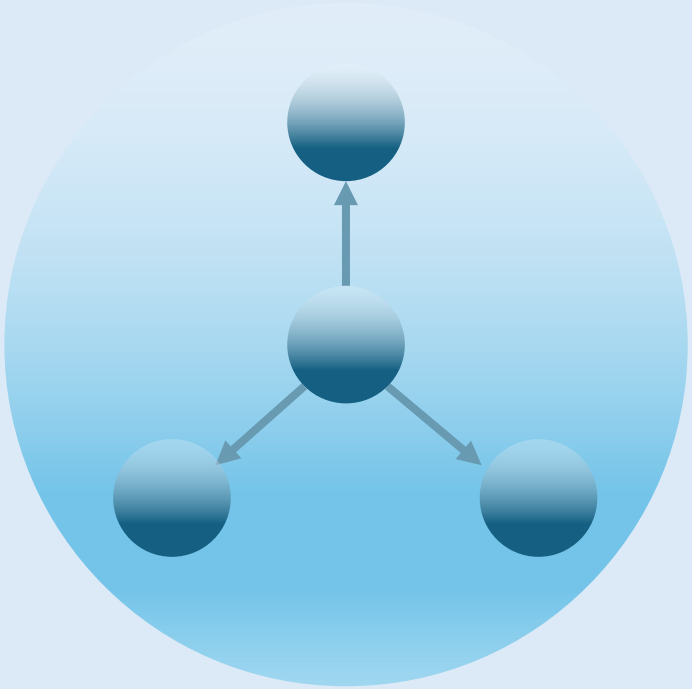


Questions and discussion



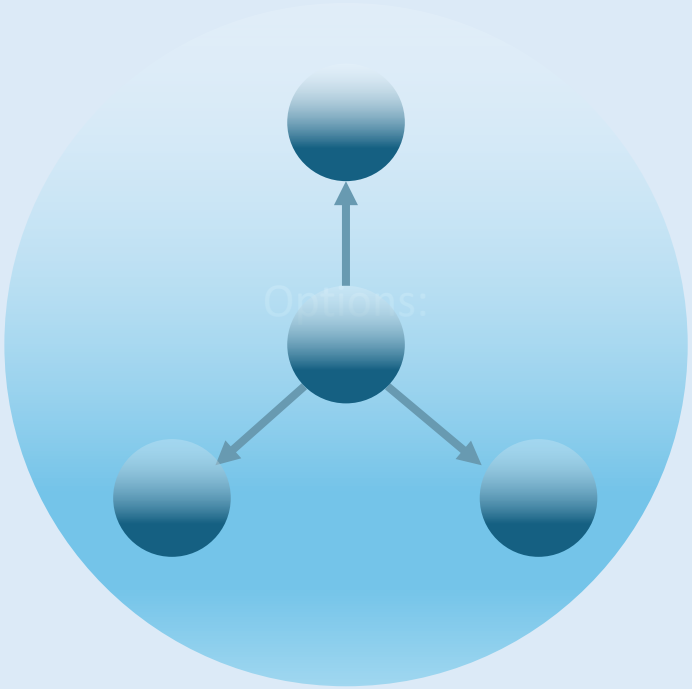
ARE YOU CLEAR ABOUT …

1. How to use the visualisation tool to see how classes are linked in the BCIO?
2. How to use this to help get ideas about classes for particular projects?



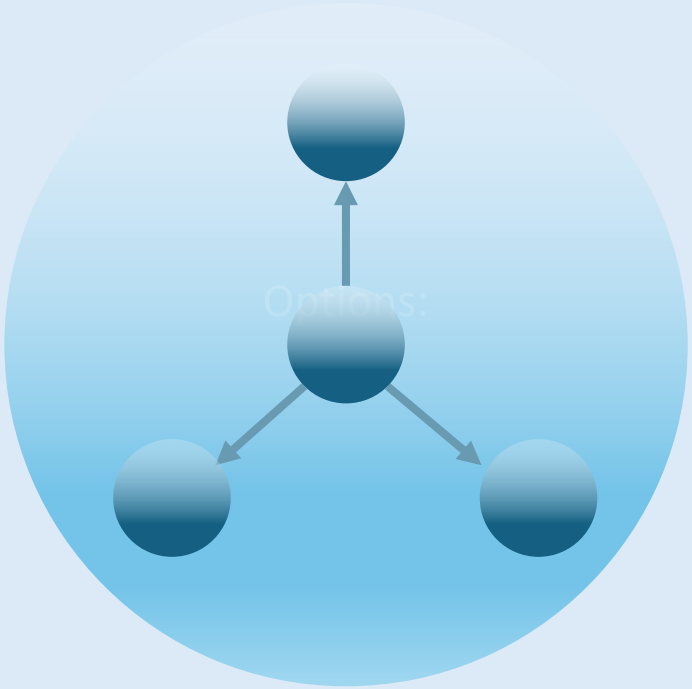
Using ontologies to characterise interventions

Options for using ontology classes in documents



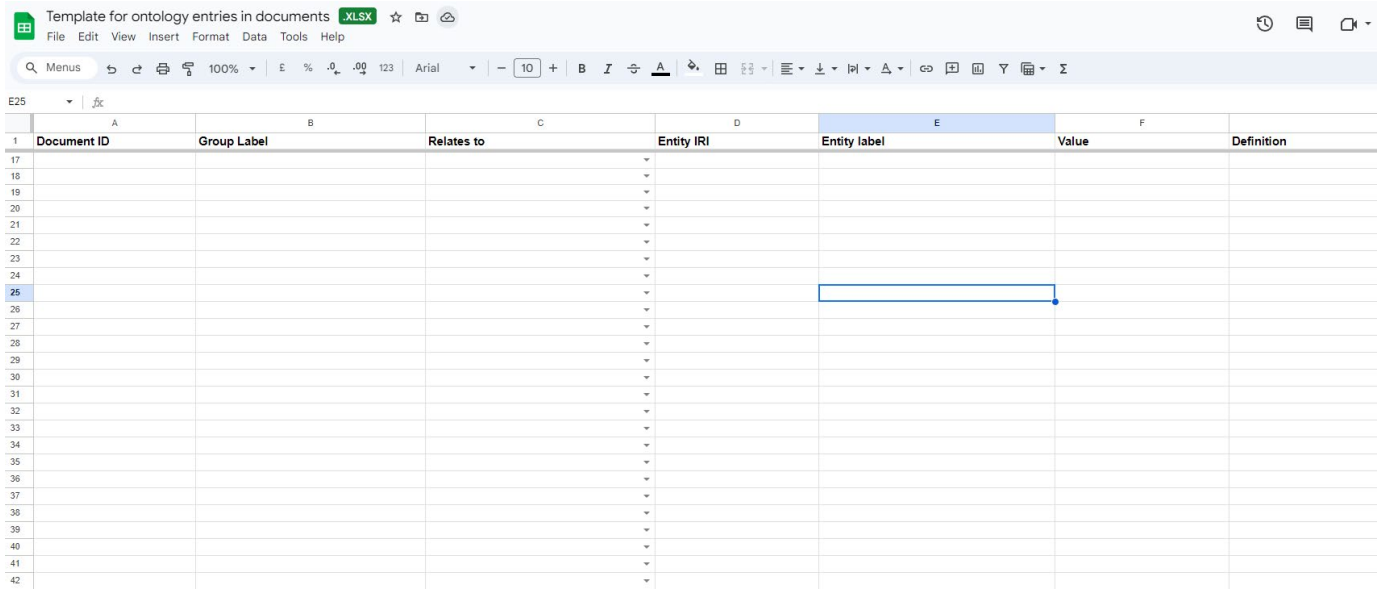
1. Create table in a supplementary file and refer to it in the document
2. Cite classes in the document as references
3. Use the free online Paper Authoring Tool

Using a supplementary file

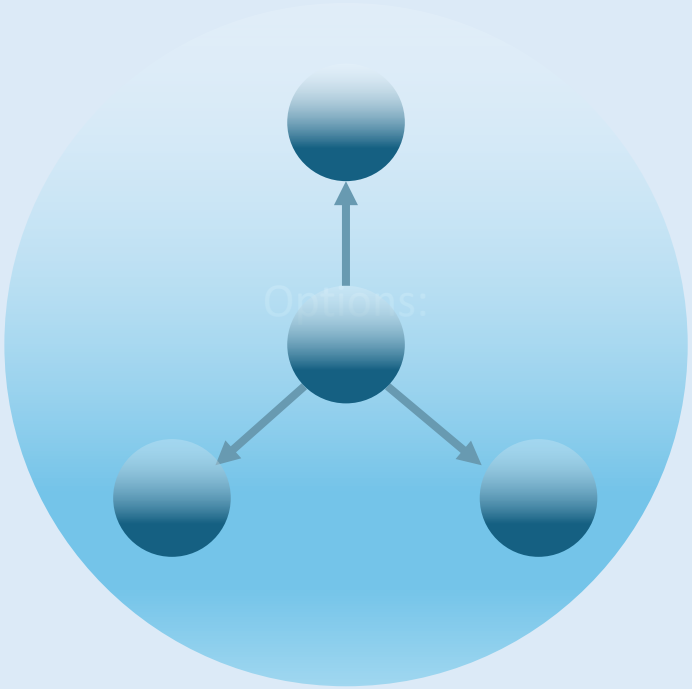


ONLINE DEMO

https://docs.google.com/spreadsheets/d/19pI3xLTGI0WNkz4LQbtqxYB0FVZ2VXdq/edit?usp=sharing&ouid=115919746559197185668&rtpof=true&sd=true



Using a supplementary file



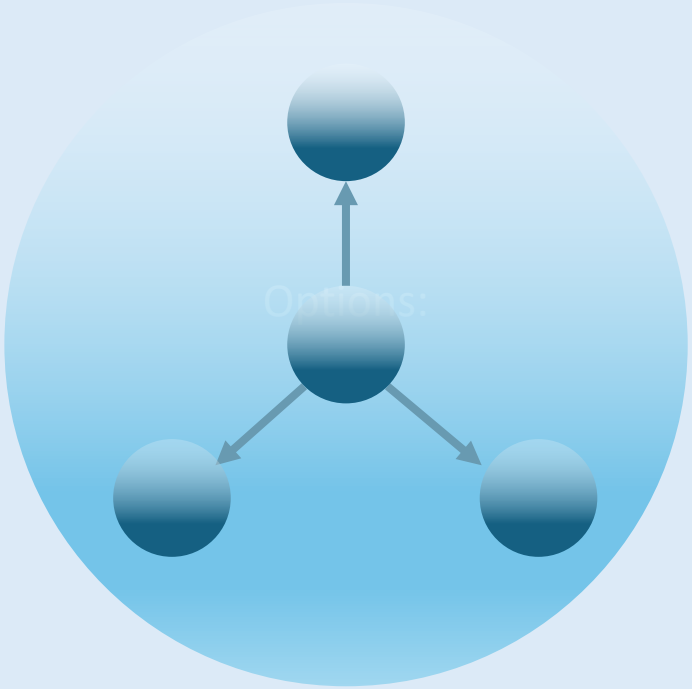
EXERCISE

Document: https://doi.org/10.1016/S0140-6736(11)60701-0
Study group: Text2Stop Intervention

Participants in the intervention group were asked to set a quit date (1). Messages encouraged participants to persevere with the quit attempt (2). They provided positive feedback (3) and emphasised the benefits achieved by quitting (4) and provided information about the consequences of smoking (5), and how others would approve of quit success (6). They prompted participants to get rid of cigarettes, ashtrays, and lighters (7), and to avoid environments where they would normally smoke (8), and encouraged participants to identify the challenges of quitting and plan how to overcome them (9). The messages also promoted the use of nicotine replacement therapy (10).

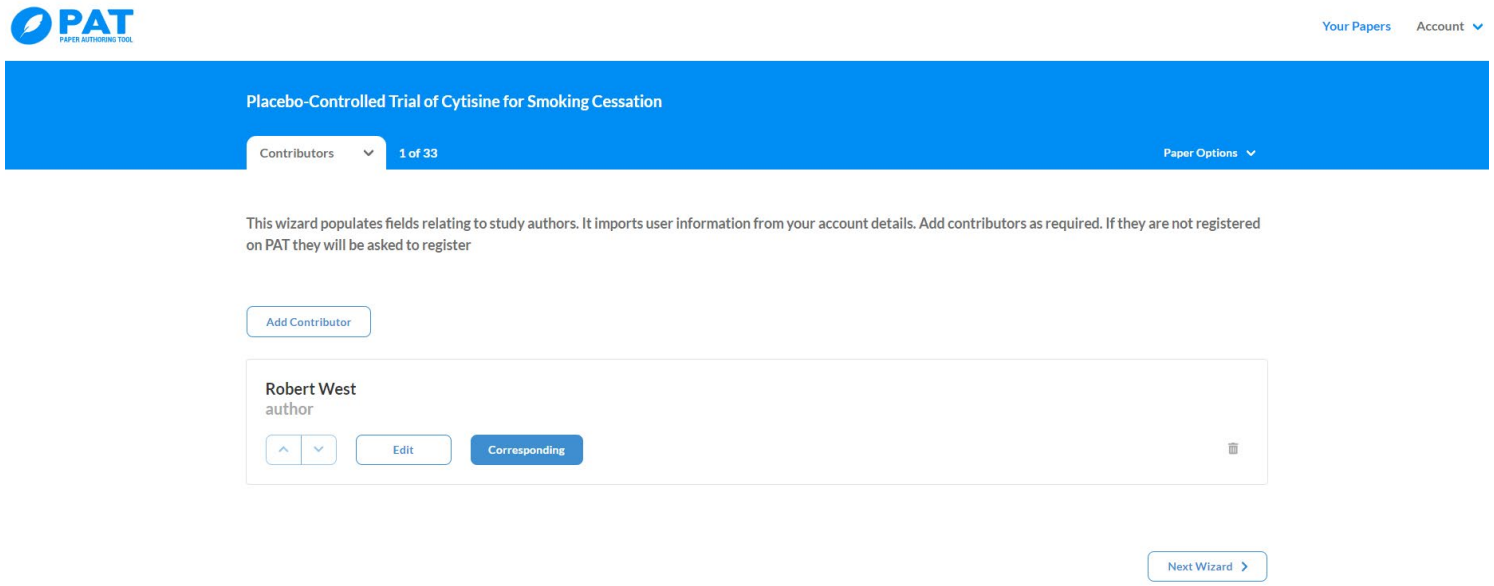
https://docs.google.com/spreadsheets/d/19pI3xLTGI0WNkz4LQbtqxYB0FVZ2VXdq/edit?usp=sharing&ouid=115919746559197185668&rtpof=true&sd=true

Using the Paper Authoring Tool

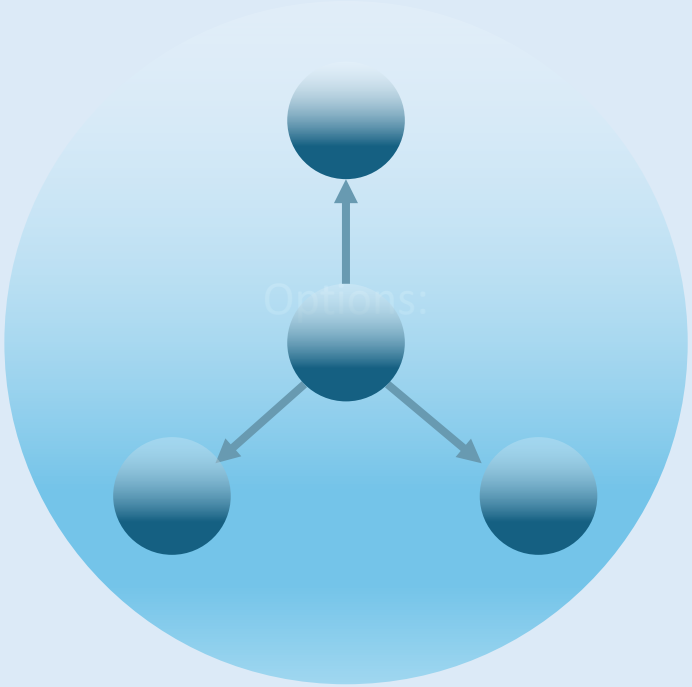


ONLINE DEMO

https://paperauthoringtool.com/



Data extraction template



ONLINE DEMO

https://osf.io/x6afp

Behaviour Change Intervention Ontology (BCIO) data extraction template (v1)

This document provides a template to annotate intervention evaluation reports according to the Behaviour Change Intervention Ontology (BCIO), developed as part of the Human Behaviour-Change Project https://wellcomeopenresearch.org/collections/humanbehaviourchange. This will primarily be useful for reporting ontology annotation within evidence synthesis projects, such as systematic or scoping reviews.

Ontology entities provided in this template reflect the published versions of each ontology within the BCIO. References are provided on each Excel tab. This data extraction template includes all published ontologies within the BCIO (current as of 13/10/23):

- Mode of Delivery Ontology: Marques et al. (2021). https://doi.org/10.12688/wellcomeopenres.15906.2
- Intervention Setting Ontology: Norris et al. (2020). https://doi.org/10.12688/wellcomeopenres.15904.1
- Intervention Source Ontology: Norris et al. (2021). https://doi.org/10.12688/wellcomeopenres.16682.1
- Mechanism of Action Ontology: Schenk et al. (2023). https://doi.org/10.12688/wellcomeopenres.19489.1 Full ontology: https://osf.io/pkq4e
- Behaviour Change Technique Ontology (BCTO): Marques et al. (2023). https://doi.org/10.12688/wellcomeopenres.19363.1 Full ontology: https://osf.io/ya74q
- Style of Delivery Ontology: Wright et al. (2023). https://doi.org/10.12688/wellcomeopenres.19899.1

This template is informed by the data extraction sheets used in Wuerstl KR, Todd K, Lawrason S, Shwed A, Holmes B, Gainforth HL. Theoretical components of smoking cessation interventions for persons with physical disabilities: A scoping review. Addict Behav. 2023;145:107762. doi:10.1016/j.addbeh.2023.107762 (Supplementary Files on OSF https://osf.io/gzqf5/)

Please cite use of this template: Norris, E., Froome, H., & Zhang, L. (2023). Behaviour Change Intervention Ontology (BCIO) data extraction template. https://doi.org/10.17605/OSF.IO/ERH75

If you have any queries on how to use this template, suggestions for improvements, or if you would like to share an alternative template that you have developed, please fill in this Google Form: https://forms.gle/Tgs1xZeqERrDMqNBA

Alternatively, please contact Dr Emma Norris: emma.norris@brunel.ac.uk

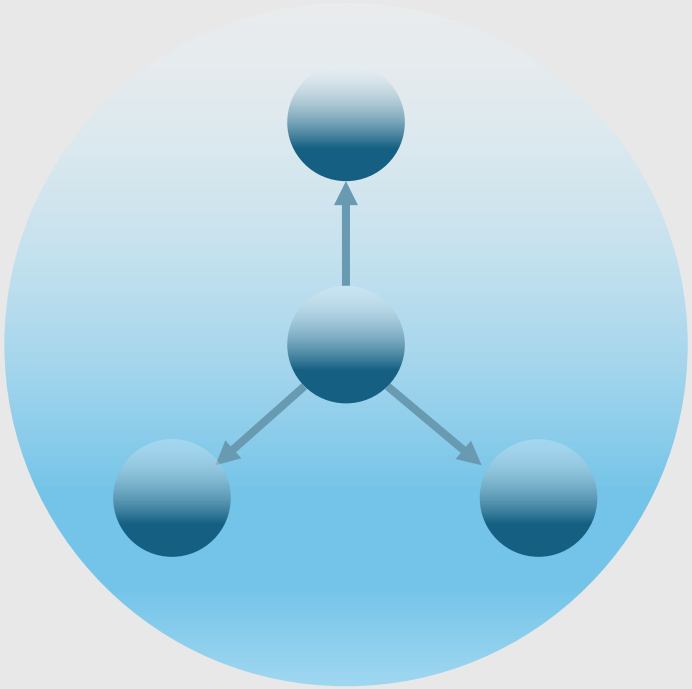
In the future, we will update this template based on: (i) feedback from the community, (ii) newly completed ontologies within the BCIO, (iii) revisions to existing ontologies. Please check https://doi.org/10.17605/OSF.IO/ERH75 for the latest version

How to use this data extraction template

1. Annotate your identified intervention evaluation reports according to each ontology within this data extraction template.
2. Indicate the presence of an entity in a given article by marking it with a '1' in the corresponding cell (this is to allow computers to extract and aggregate the data)
3. Add quote(s) from the article as evidence to support your annotation for each entity.
4. Repeat steps 2-3 as required, by adding columns for each additional article.
5. If applicable, you can add additional intervention arms for a given article by adding more columns.

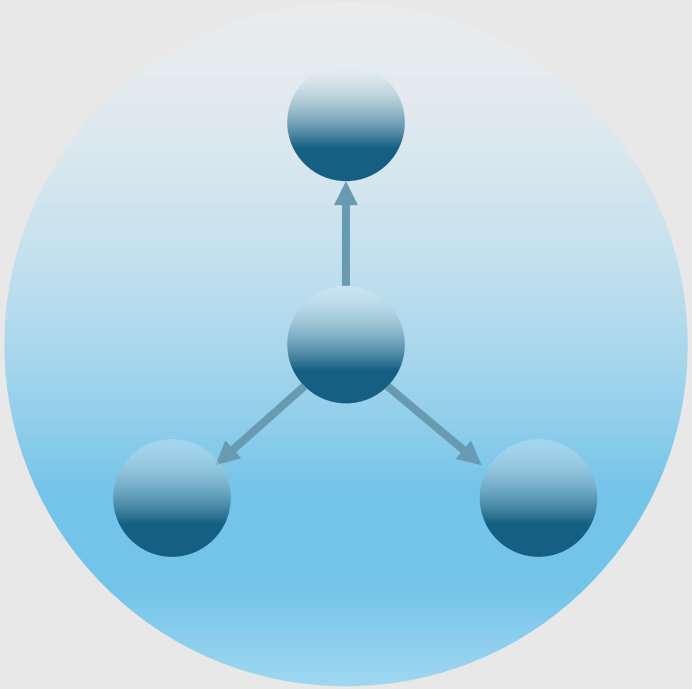
Example:

					Article 1 (Author X, 2023)				Article 2 (Author Y, 2023)			
Ontology X					Intervention		Comparator		Intervention		Comparator	
ID	Level 1	Level 2	Level 3	Definition	Entity present	Evidence	Entity present	Evidence	Entity present	Evidence	Entity present	Evidence
BCIO:XXX	Entity 1			Entity 1 definition	1	xxxx						
BCIO:YYY		Entity 2		Entity 2 definition							1	yyyy
BCIO:ZZZ			Entity 3	Entity 3 definition								



Suggesting new ontology classes

Why suggest new classes

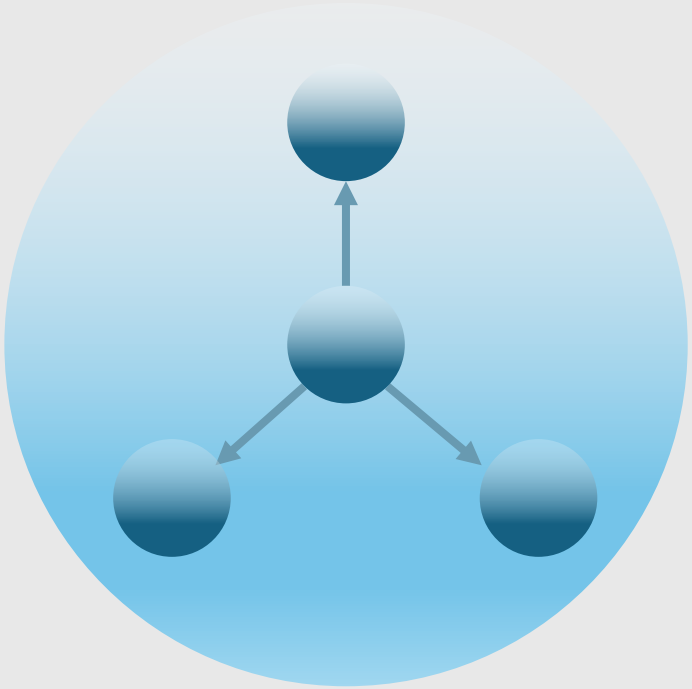


Ontologies are intended to grow and evolve with the user base

New classes will always be needed:

- to fill gaps
- to capture more specific classes
- to capture new constructs

How to suggest new classes



Follow the instructions on the BCIO website

https://www.bciontology.org/contribute

How to suggest new entities and relationships for the BCIO

The BCIO is intended to be a growing resource and its ongoing development benefits from community input. If you have a query or would like to contribute to the BCIO, please submit an issue on **Github** (you may need create a free account).

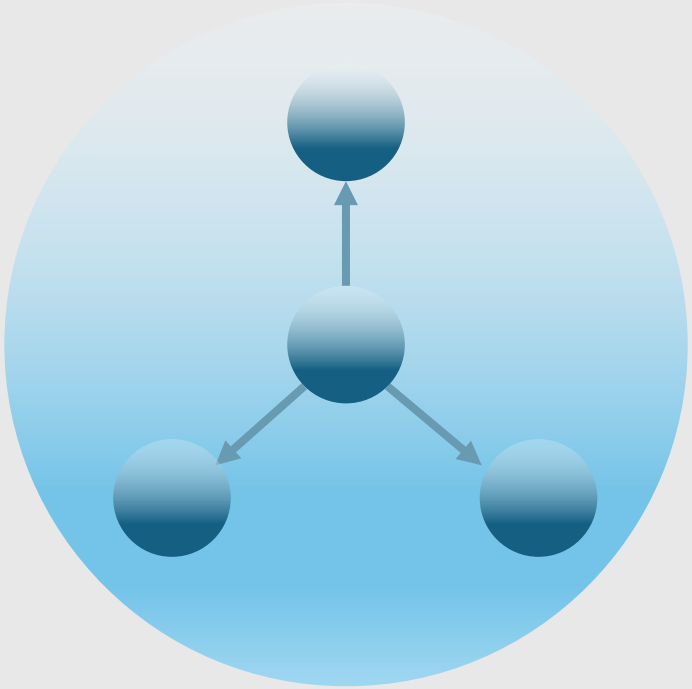
Through Github you can submit requests or suggestions to:

- add new entities
- revise the labels or definitions of existing entities
- add new synonyms or examples
- report typos, errors or bugs

We strongly encourage users to submit issues on Github to allow us to publicly track and respond to requests from the community. This is to reflect the **Open Biological and Biomedical Ontology (OBO) Foundry principles** of good practice in ontology development.

If you want to discuss an idea ahead of suggesting a new class, email us at:

info@bciontology.org



Discussion and next steps

Sign up to the user group:
https://groups.google.com/g/bcio-user-support

humanbehaviourchange@gmail.com

THANK YOU!

BCIO part of HB CP

UCL CENTRE FOR BEHAVIOUR CHANGE

2024 CONFERENCE

10th Anniversary Edition

www.ibtnetwork.org

ibtn international behavioural trials network