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The Drosophila Anatomy Ontology



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More Virtual Fly Brain posters at: 21 & 141

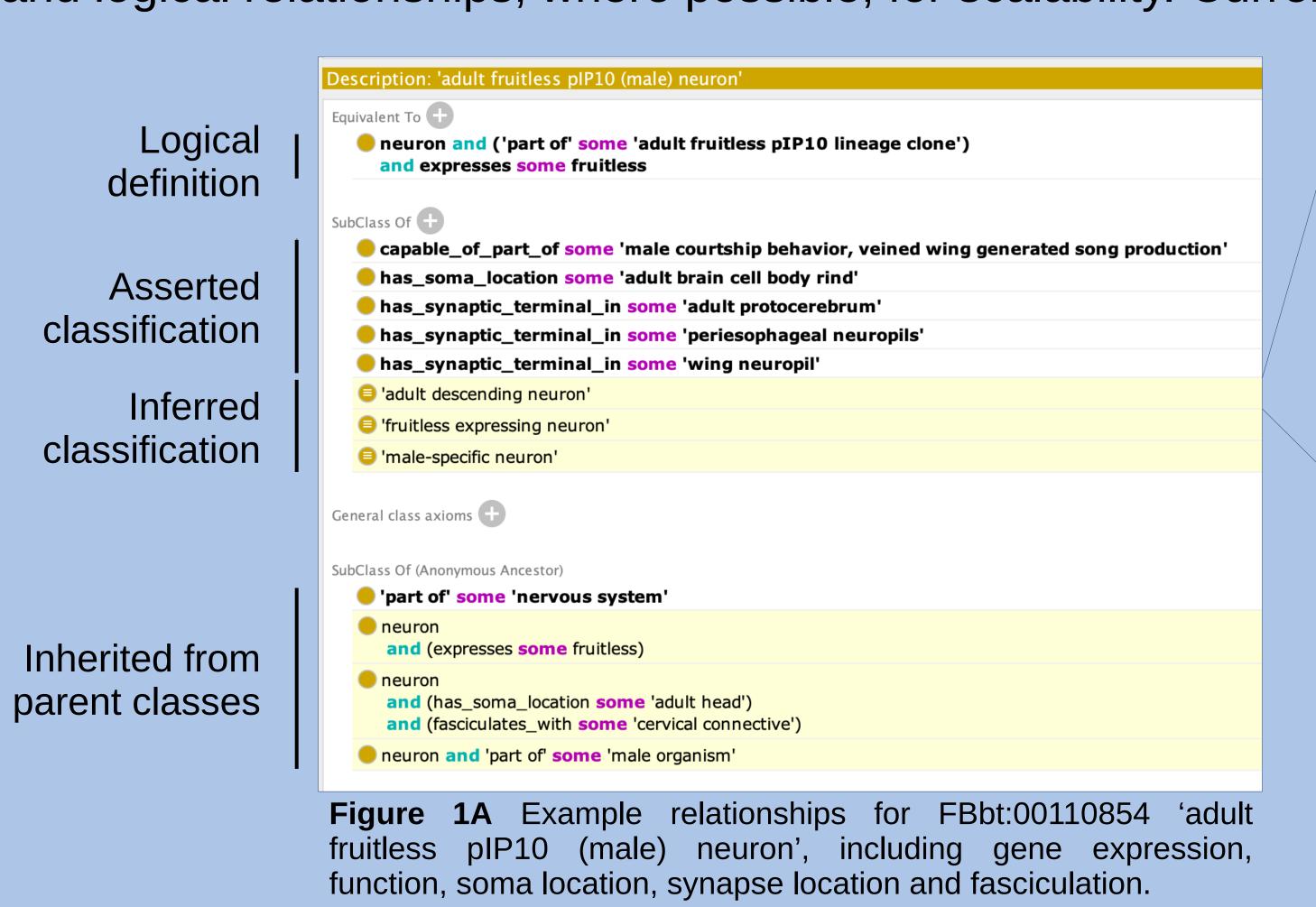
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Introduction

The Drosophila Anatomy Ontology (DAO) is a queryable store of knowledge about Drosophila anatomy, including cell types as well as larger structures. The majority of new terms currently being added are for components of the nervous system and the ontology is being maintained and updated as part of a collaboration between FlyBase (flybase.org) and Virtual Fly Brain (v2.virtualflybrain.org).

Classification

The DAO supports multiple types of classification used by biologists to describe anatomical features. We use inferred classification and logical relationships, where possible, for scalability. Currently, 35% of over 13,500 classifications are inferred.



Explanation for: 'adult fruitless pIP10 (male) neuron' SubClassOf 'adult descending neuron'

'adult fruitless pIP10 (male) neuron' EquivalentTo neuron and ('part of' some 'adult fruitless pIP10 (male) lineage clone') and (expresses some fruitless)

'adult fruitless pIP10 (male) neuron' SubClassOf has_soma_location some 'adult brain cell body rind'

'adult brain cell body rind' SubClassOf 'part of' some 'adult brain'

'adult brain' SubClassOf 'part of some 'adult head'

has_soma_location SubPropertyOf: overlaps

'adult fruitless pIP10 (male) neuron' SubClassOf has_synaptic_terminal_in some 'wing neuropil'

'wing neuropil' SubClassOf 'part of some 'adult mesothoracic neuromere'

'adult mesothoracic neuromere' SubClassOf 'part of some 'thoracico-abdominal ganglion'

has_synaptic_terminal_in SubPropertyOf: overlaps

neuron and (overlaps some 'adult brain') and (overlaps some 'thoracico-abdominal ganglion') SubClassOf fasciculates_with some 'cervical connective'

has_synaptic_terminal_in o 'part of' SubPropertyOf: has_synaptic_terminal_in

has_soma_location o 'part of' SubPropertyOf: has_soma_location

'adult descending neuron' EquivalentTo neuron and (has_soma_location some 'adult head') and (fasciculates_with some 'cervical connective')

Figure 1B Logical explanation for inferred classification as 'adult descending neuron'.

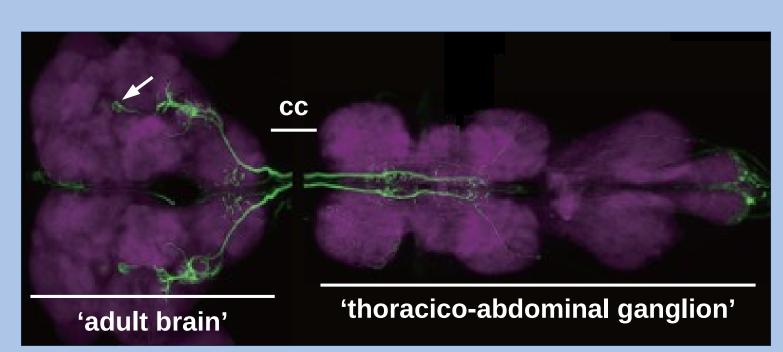


Figure 1C Example 'adult descending neuron' (DNp02¹) illustrating the features used for classification in Figure 1B. Neurons that have parts in the 'adult brain' and the 'thoracico-abdominal ganglion' must pass though the 'cervical connective' (cc). A neuron that has its soma (arrow) in the 'adult head' and passes through the 'cervical connective' is an 'adult descending neuron'¹.

Semi-automated addition of terms

We use patterns and templates to improve consistency and save time when adding a large set of similar terms.

```
A name:
                                                               logical_axioms:
      text: "%s-sensing neuron of %s leg
     tarsal taste bristle %s"
                                                                  axiom_type: equivalentTo
                                                                  text: "FBbt:00005106 that 'capable_of' some %s
      vars:
        - mode 1
                                                               and 'has_postsynaptic_terminal_in' some %s"
        - leg_name
                                                                   vars:
        - sensillum
                                                                    - mode ID
                                                                    - sensillum_ID
                                                                         Description: 'sugar-sensing neuron of mesothoracic leg tarsal taste bristle 4s'
      'sugar-sensing neuron of the leg'
       sugar-sensing neuron of mesothoracic leg tarsal taste bristle 4s'
                                                                         Equivalent To
      'sugar-sensing neuron of mesothoracic leg tarsal taste bristle 5b'
                                                                           neuron
      'sugar-sensing neuron of mesothoracic leg tarsal taste bristle 5v'
                                                                              and (has_postsynaptic_terminal_in some 'mesothoracic leg tarsal
      'sugar-sensing neuron of metathoracic leg tarsal taste bristle 4s'
      'sugar-sensing neuron of metathoracic leg tarsal taste bristle 5b'
                                                                              and (capable_of some 'detection of chemical stimulus involved in
      'sugar-sensing neuron of metathoracic leg tarsal taste bristle 5v'
                                                                              sensory perception of sweet taste')
      'sugar-sensing neuron of prothoracic leg tarsal taste bristle 2b'
      'sugar-sensing neuron of prothoracic leg tarsal taste bristle 3b'
      'sugar-sensing neuron of prothoracic leg tarsal taste bristle 4b'
                                                                         SubClass Of
      'sugar-sensing neuron of prothoracic leg tarsal taste bristle 4s'
                                                                           'mesothoracic leg taste bristle chemosensory neuron'
      'sugar-sensing neuron of prothoracic leg tarsal taste bristle 5b'
      'sugar-sensing neuron of prothoracic leg tarsal taste bristle 5s'
                                                                           'sugar-sensing neuron of the leg'
      'sugar-sensing neuron of prothoracic leg tarsal taste bristle 5v'
```

Figure 2 Generation of groups of similar terms using Dead Simple Owl Design Patterns (DOSDP)². **A** Partial pattern showing generation of name and logical definition using variables stored in a seperate .tsv file. **B** Some of the terms generated, showing a logical definition and some inferred classification.



Figure 3 Generation of groups of similar terms using ROBOT³. This method allows greater flexibility than DOSDP, but is more labour-intensive. **A** Part of input spreadsheet giving various details about a large (~100) group of neuron classes. A python script was used to convert this data into a ROBOT template, used by ROBOT to generate an .owl file, which was merged into the DAO. **B** & **C** Asserted classification (**B**) and annotations (**C**) on one of the ROBOT-generated classes (DNa01).

Neuroanatomical queries

The curated knowledge in the ontology can be used to find neurons matching certain criteria via the Virtual Fly Brain website.

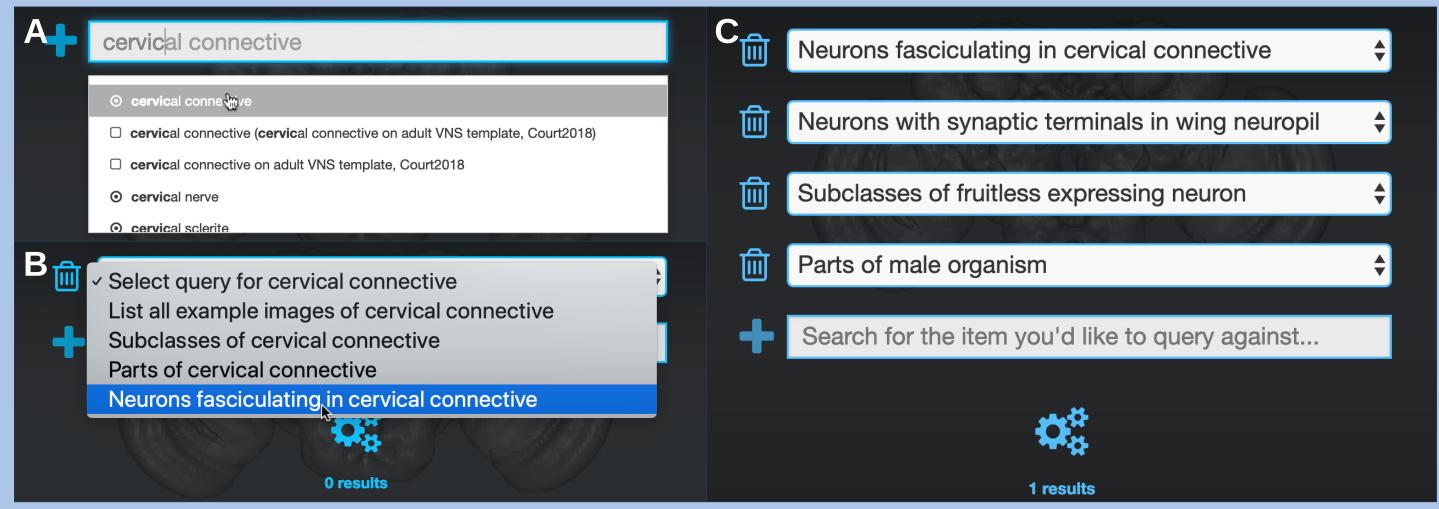


Figure 4 Building a query on Virtual Fly Brain. **A** Find an anatomy term. **B** Select a query based on chosen anatomy term. **C** Multiple queries can be combined, probing different types of biologically meaningful classification; these example queries each match 'adult fruitless pIP10 (male) neuron' (see above) among other results.

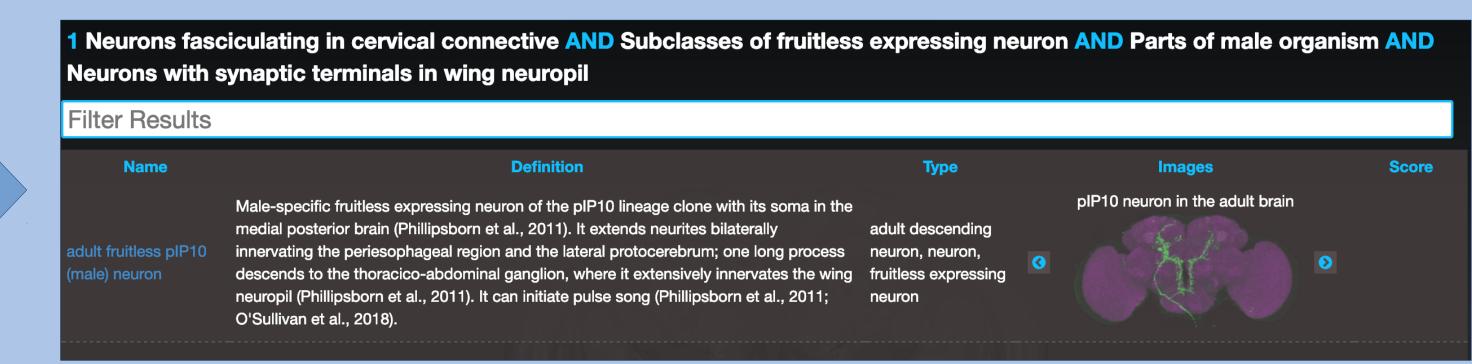


Figure 5 Entities that match all queries are listed with descriptions and thumbnails (where images are available) in the results table.