

Accelerating Adoption of NAMs with FAIR Principles

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Highlights

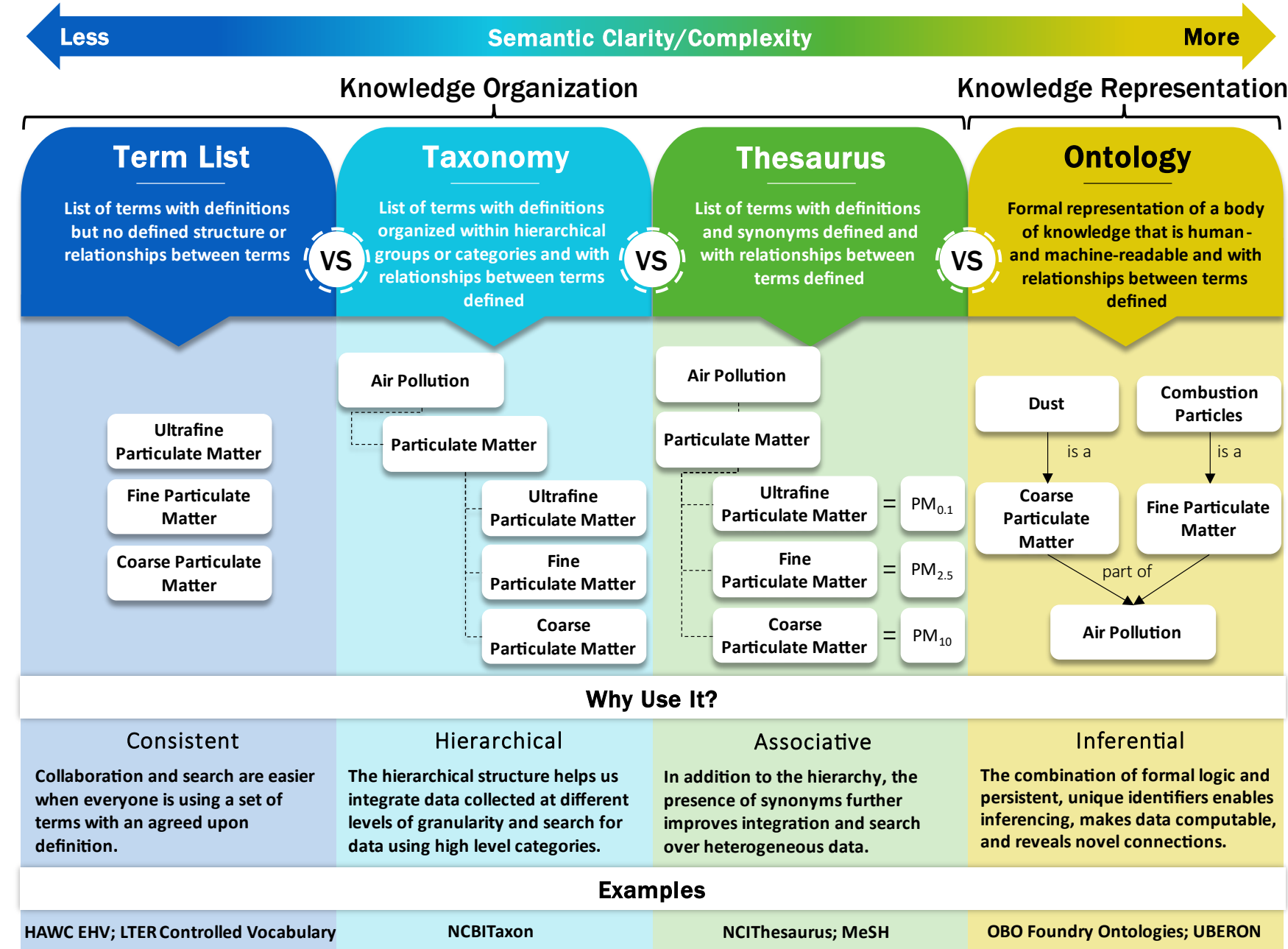
- Data obtained using new approach methodologies (NAMs), particularly in vitro assays, require additional context to link to in vivo toxicity endpoints
- NIEHS and the National Toxicology Program (NTP) support adoption of knowledge organization systems and FAIR data principles to further scientific advancement in environmental health sciences
- Improving the FAIRness of data is critical for providing data context and enabling the information integration needed for assessment, interpretation, and method development
- Examples from two NTP resources exemplify the value of using structured knowledge organization to support FAIR data principles.

What are FAIR data principles?

- Findable**
 - Data is findable by people and machines using unique and persistent IDs accompanied by rich metadata
- Accessible**
 - (Meta)data are accessible in an open and standardized format
- Interoperable**
 - A formal, broadly applicable knowledge organization system is used to describe (meta)data and relationships
- Reusable**
 - (Meta)data are well described to promote integration with other resources

Annotation of data to support FAIR

Data annotation using knowledge organization impart standardization and structure needed to achieve data FAIRness



Environmental Health Science Language Collaborative

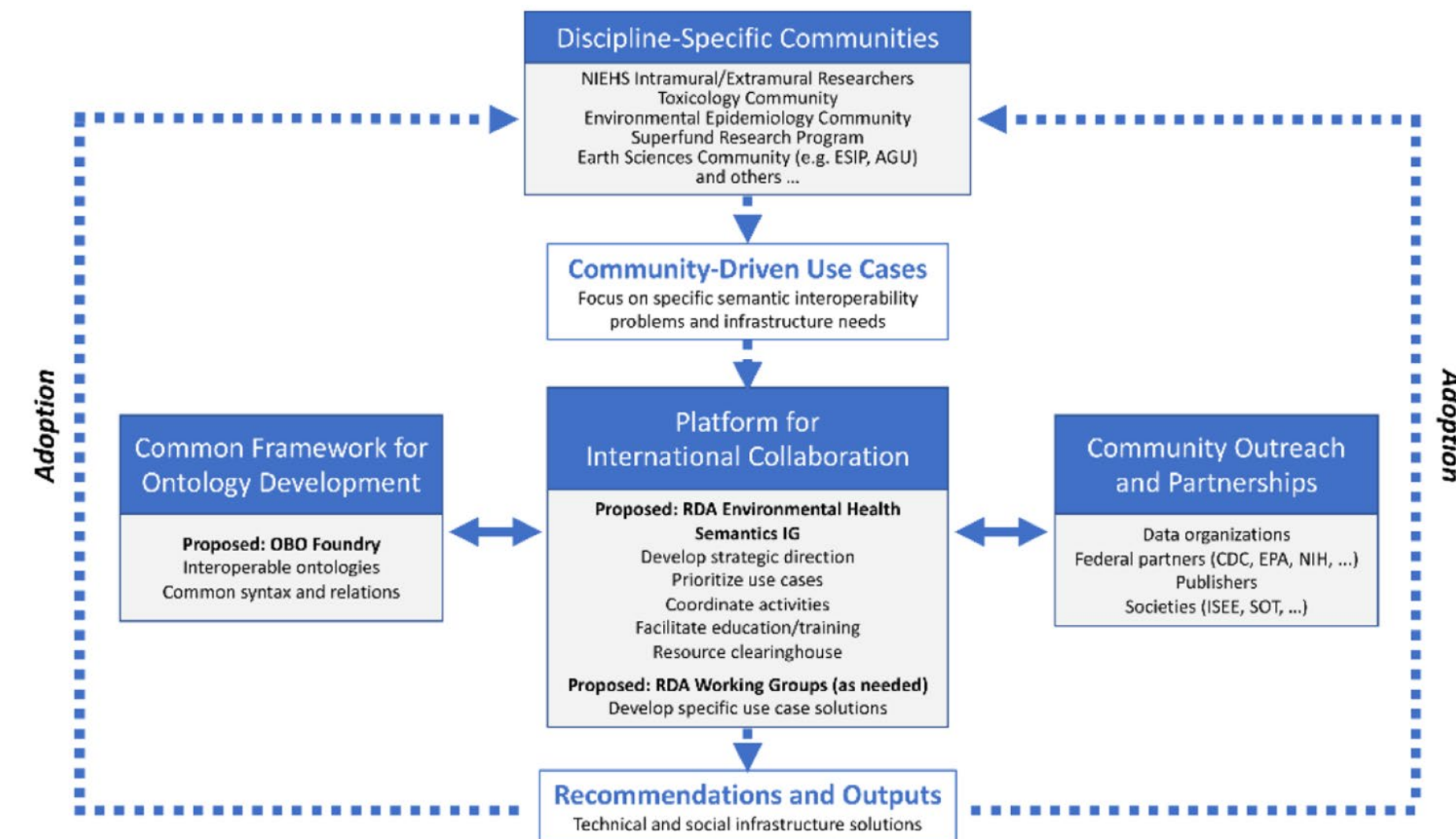
National Institute of Environmental Health Sciences (NIEHS) sponsored a September 2021 virtual workshop focused on **building a sustainable community and developing sustainable semantic solutions** to support the advancement and adoption of harmonized environmental health language approaches

Participants identified a need for:

- Increased tools and education to support adoption
- Reporting requirements by journals and funding agencies

Workshop report describing the needs and outcomes forth coming; preworkshop commentary available:

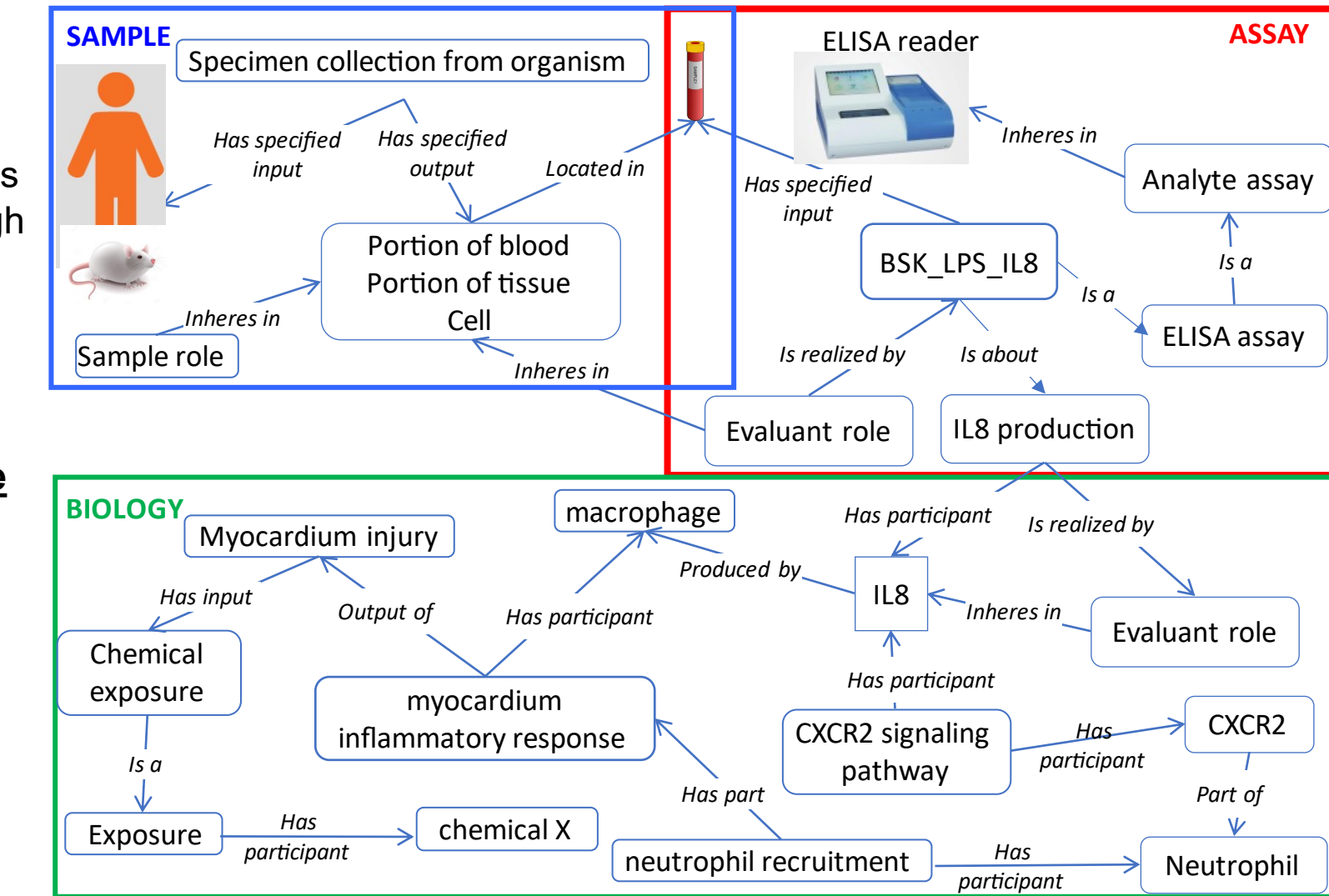
<https://www.mdpi.com/1660-4601/18/17/8985>



For more information on the community effort:
<https://www.niehs.nih.gov/research/programs/ehlc/index.cfm>

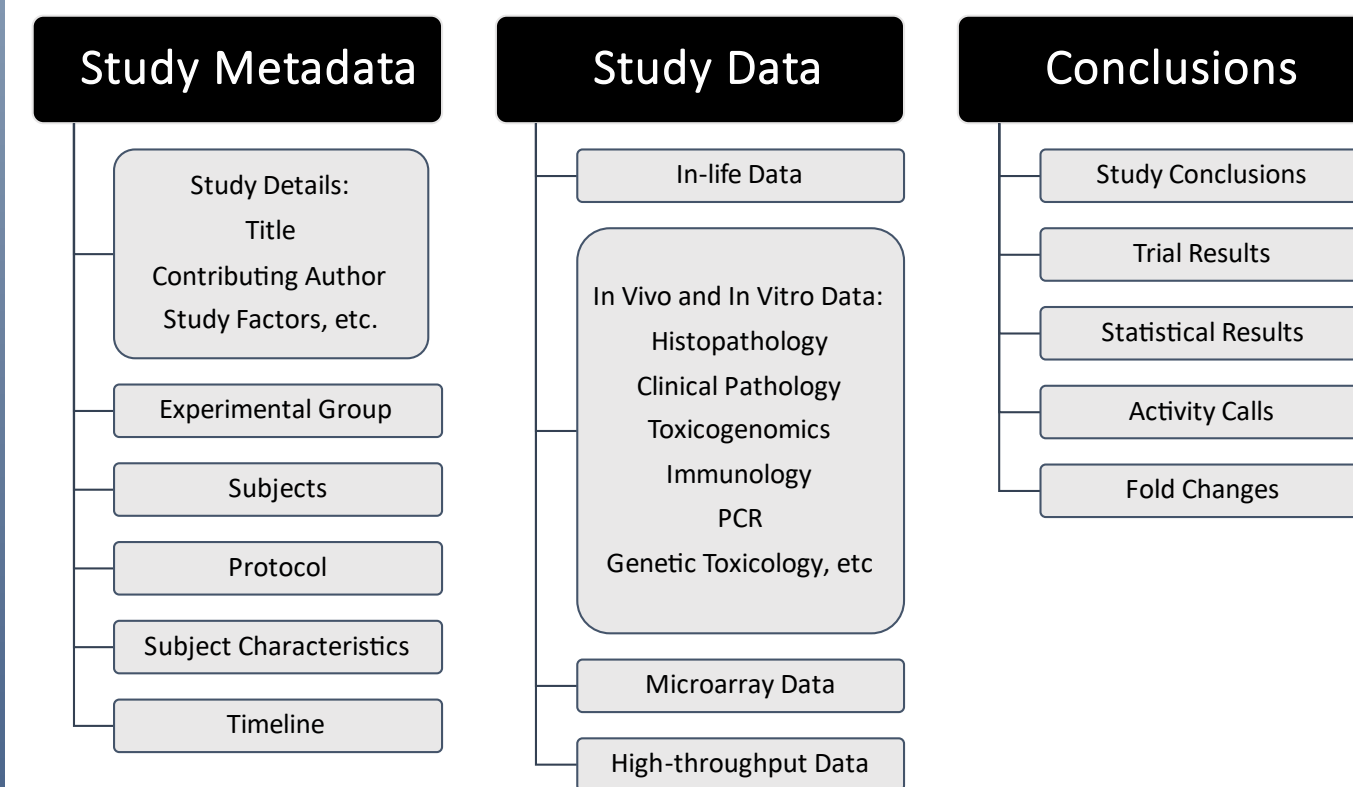
Why make your data FAIR?

- Adding annotation makes it easier to **find** your data and use it in a purposeful way
- Builds connections between **in vivo** endpoints and **in vitro** tests aiding NAMs development
- Supports **artificial intelligence** approaches to **finding and integrating** information and knowledge
- NTP is working on incorporating **knowledge representations** into data that connect in vitro assays to in vivo outcomes through the underlying biology
- By **specifying the relationships** between entities and roles they fill, **interpreting the outcome** of an assay becomes easier for non-domain experts
- These same relationships support **ontology-driven AI** approaches for NAMs



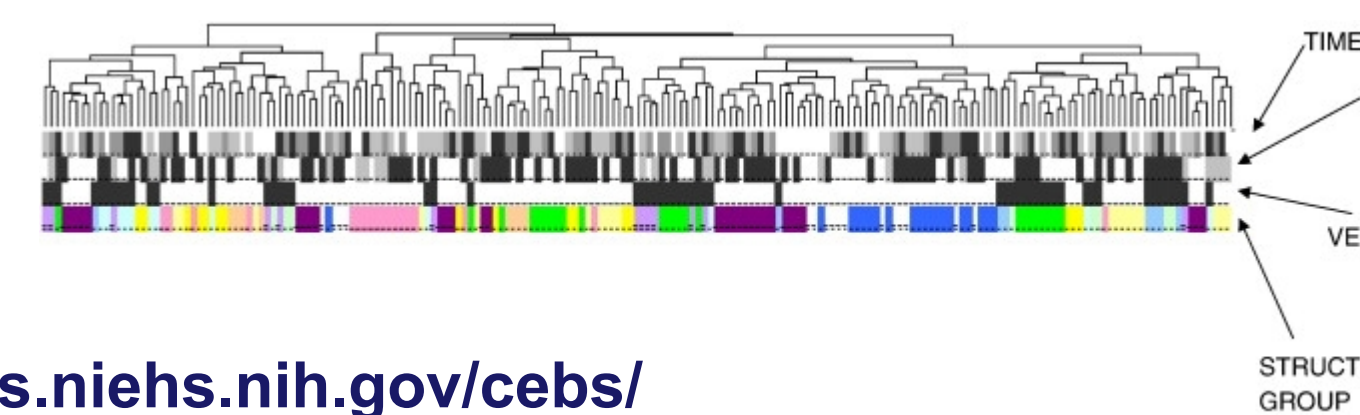
What do FAIR principles look like in a data repository?

- The NTP's Chemical Effects in Biological Systems (CEBS) is a comprehensive and unique toxicology resource containing individual and summary in vivo and in vitro data from NTP and other depositors
- Annotation of study information using knowledge organization systems in CEBS improves **accessibility** and **interoperability** of data



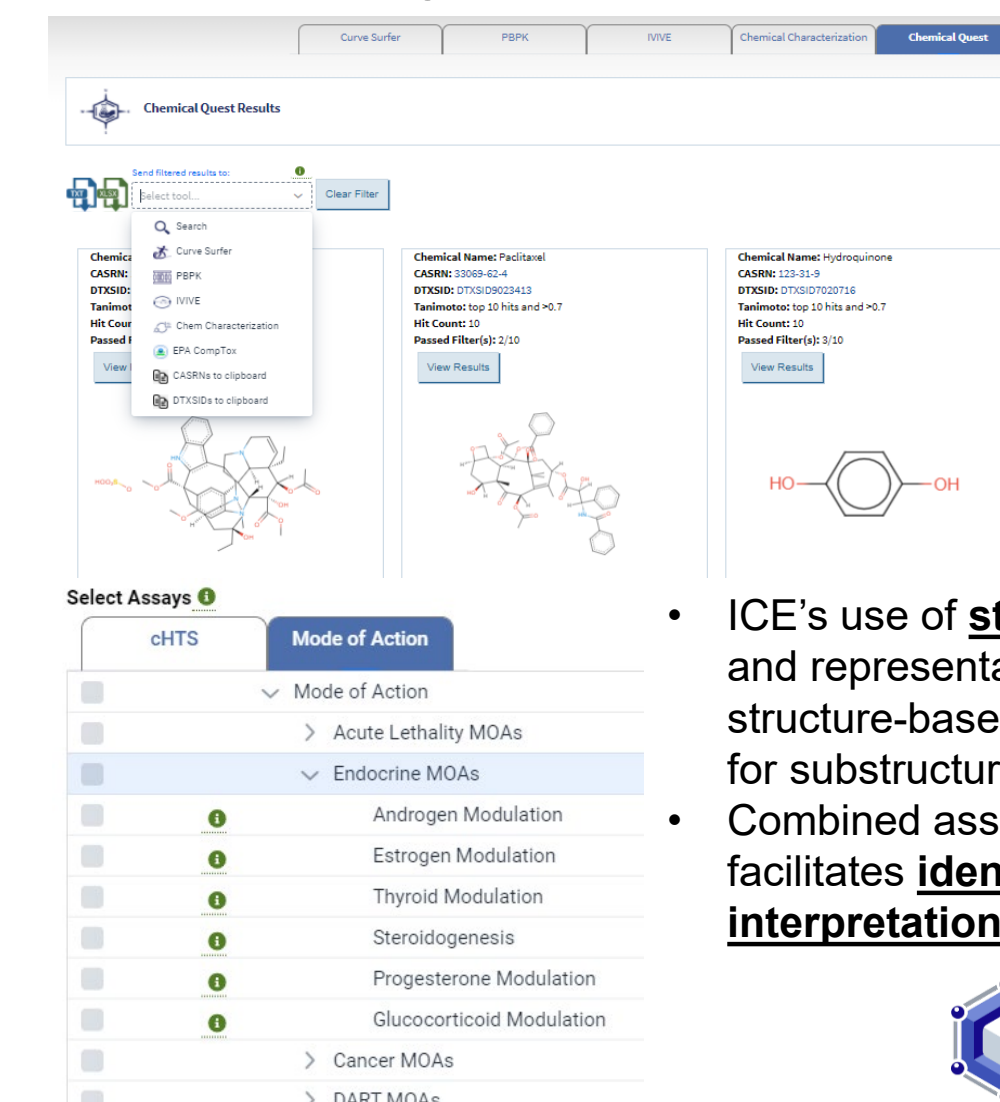
Use of standardized terminology allows for data to be integrated across multiple studies to facilitate study integration and allows for additional knowledge discovery

<https://cebs.niehs.nih.gov/cebs/>



Improving access to NAM data and tools using FAIR

- The NTP's Integrated Chemical Environment (ICE) provides stakeholders access to data and tools supporting NAMs
- ICE relies on curation by domain experts to improve the **findability** of data for diverse users and the **accessibility** of the data from ICE tools
- Annotation of mechanistic in vitro assays to standardized terminology improves the **findability** of data and its **reuse** across ICE tools and beyond
- Use of standardized formats improve **interoperability** of data with information outside of ICE, including with CEBS



- ICE's use of **standard identifiers** and representation improves structure-based searching, even for substructures
- Combined assay annotation facilitates **identification** and **interpretation** of workflow results

<https://ice.ntp.niehs.nih.gov/>

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