



Northeastern University
*The Ocean Genome Legacy Center
of New England Biolabs*

Sampling and Preservation of Genomic Data and Linking Tissue Samples to Vouchers

Ocean Genome Legacy (OGL)
Northeastern University
<http://www.neu.edu/ogl>

Charlotte Seid, Ph.D.
Biorepository Manager

Why Archive Genomes?

- Genomic information can contribute to:
 - Species identification and description
 - Phylogenetics
 - Systematics
 - Biodiversity monitoring
 - Medicine and drug discovery
 - Biotechnology
 - Sustainable food and energy
 - Conservation
- We can learn more as DNA technology advances
- Urgency due to biodiversity loss



*Shared interests and fruitful collaborations
between*

genomic collections and natural history

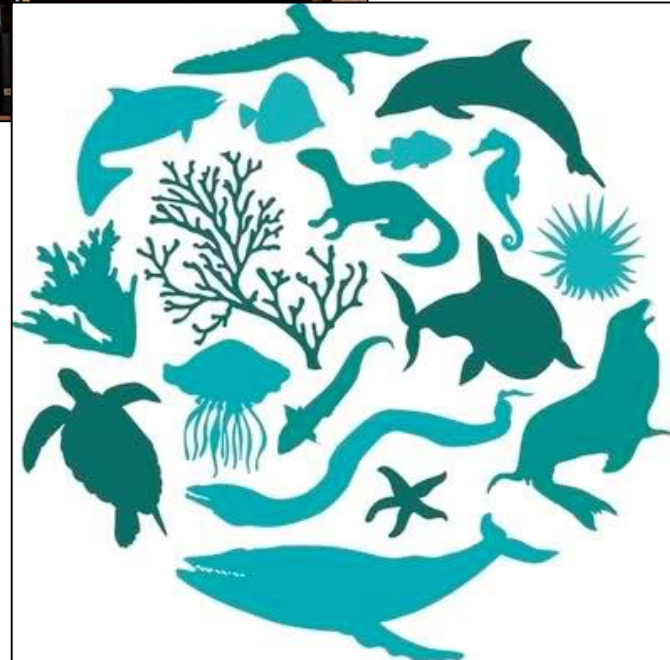
How Genome Banks Help Research and Conservation

- Make rare and valuable materials widely available
- Share the benefits of infrastructure and expertise
- Maximize scientific value of samples by sharing data
- Avoid unnecessary duplication of destructive



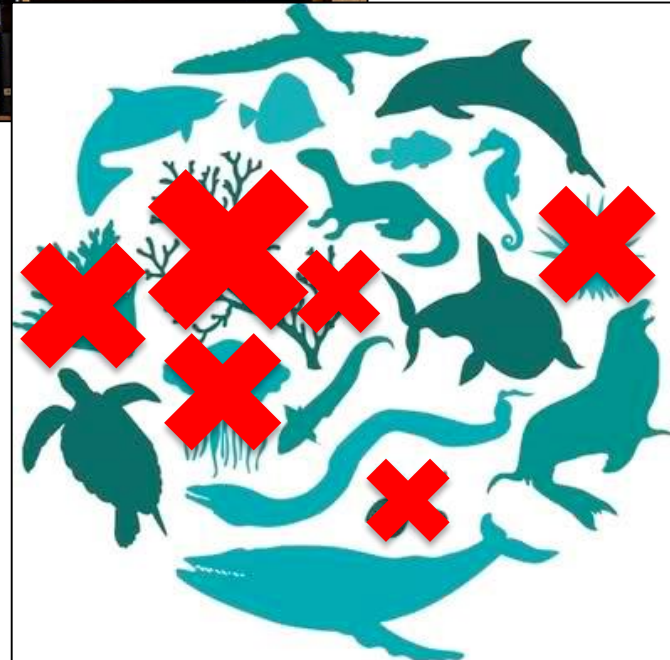
Biorepository

A non-profit archive of DNA from marine species



Biorepository

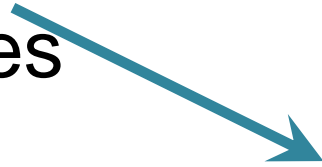
A non-profit archive of DNA from marine species



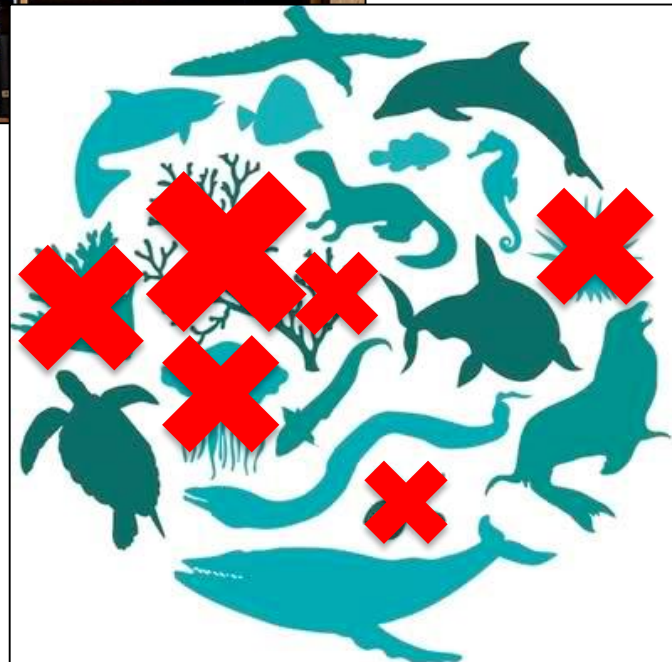
Biorepository

A non-profit archive of DNA from marine species

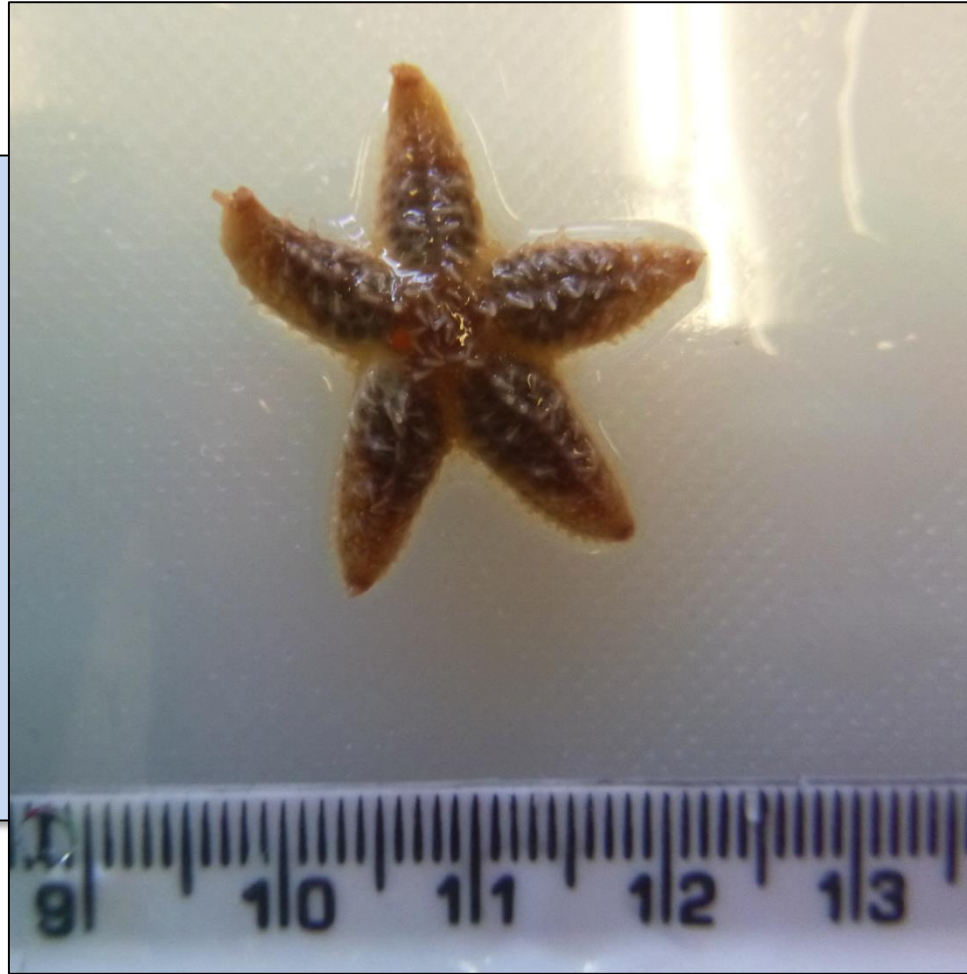
species



Samples, not sequences



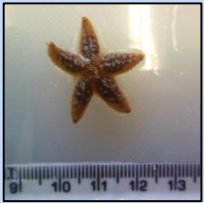
The OGL Biorepository Model



Specimens

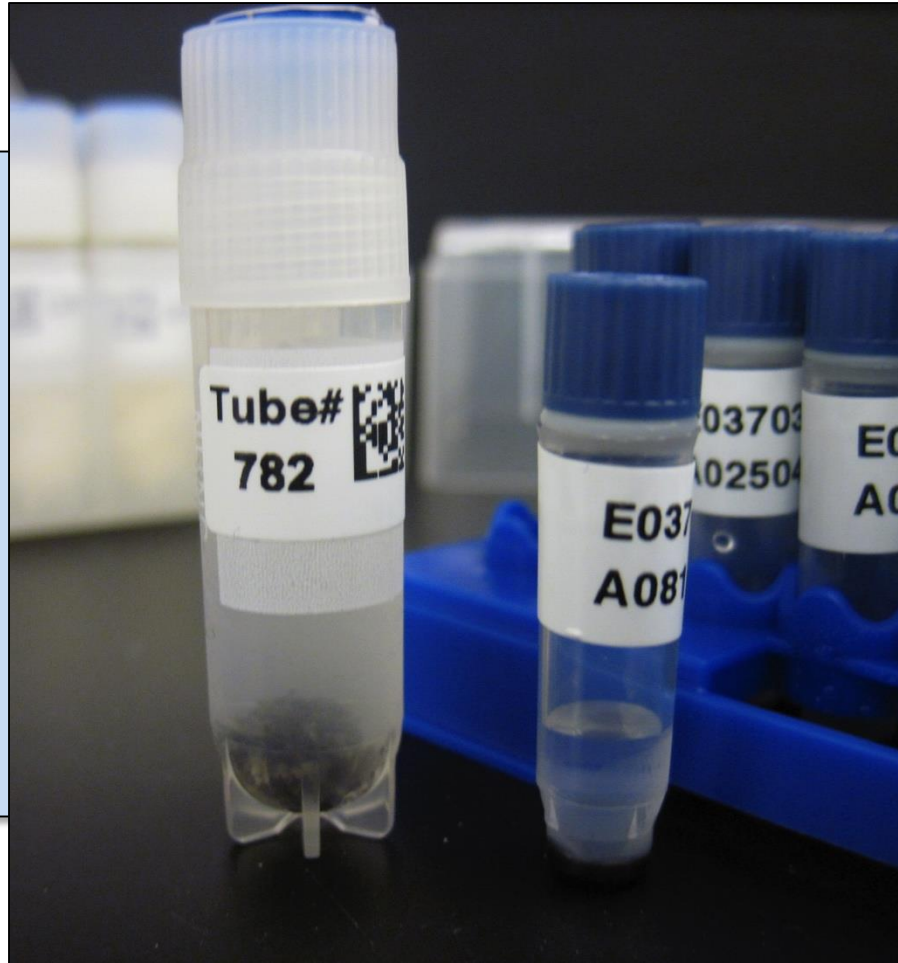
Collected by researchers, museums, and “creative”
sources

The OGL Biorepository Model



Specimens

Collected by scientists
around the world



Tissue and DNA

Prepared by OGL or by depositors

The OGL Biorepository Model



Specimen

Collected by scientists
around the world



Storage

Secure long-term preservation at the NU Marine Science Center

The OGL Biorepository Model

Northeastern University
The Ocean Genome Legacy Center
of New England Biolabs

Ocean Genome Resource Database [Home](#)

Go to related record in: [Specimens](#) [Samples](#) [Extracts](#) [Taxa](#)

Specimens

Leptochiton cancellatus Specimen ID: S00001

Scientific Name: *Leptochiton cancellatus* (Sowerby, 1840)
Verbatim Name (as deposited): *Leptochiton cancellatus*
Taxonomic Rank (lowest confident ID): Species
Common Name(s): West Indian green chiton
Taxon ID: T00002

Kingdom: Animalia
Phylum: Mollusca
Class: Polyplacophora
Order: Lepidopleurida
Family: Leptochitonidae
Genus: *Leptochiton*
Species: *cancellatus*

Fate: Held
Holding Institution: Bermuda Aquarium Museum and Zoo
Collection Code:
External ID(s):
Basis Of Record: Collected specimen
Voucher Material: Whole specimen Molecular voucher Diagnostic sample Other (describe in Notes) Image

Find/Create Taxon ID View/Edit Full Taxonomy

Specimen Samples Extracts Collection Participants Permits Images Distributions Vouchers

Extract ID	Fate	Extract Type	Sample ID	Tissue Type	Conc. (ng/ul)	Volume (ul)	Storage Location
E00050	Held	DNA	A00003	muscle	89.4	100	Unit Pasteur.Shelf 3.Rack 1.Box 1.Row F.Col 3
			A00004	muscle	44.1	100	Unit Pasteur.Shelf 3.Rack 1.Box 1.Row F.Col 4
			A00004	muscle	62.4	200	Unit Pasteur.Shelf 3.Rack 1.Box 2.Row G.Col 5

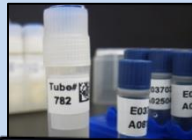
Record Modification Date: 9/25/2015 3:34:13 PM
Record Modifier Account: Charlotte Seid (admin)
Record Modifier Workstation: alphaimager

Collection Locations Collection Events Participants Permits Images Sequences QC Distributions Storage



Specimens

Collected by scientists
around the world



Pre



Public Online Catalog

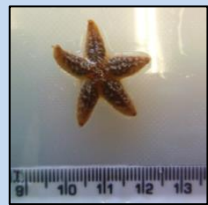
The OGL Biorepository Model



Distribution

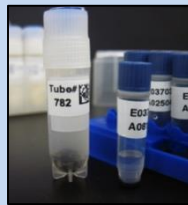
To researchers and educators around the world

The OGL Biorepository Model



Specimens

Collected by scientists around the world



Tissue and DNA

Prepared by OGL or donated by scientists



Cold Storage

Secure long-term preservation here at the Marine Science Center



Online Public Catalog



Distribution

OGL materials go to researchers around the world

Voucher Materials

For OGL's purposes, a voucher can be a:

- Preserved whole specimen or diagnostic parts
Ideally, housed and catalogued in a museum collection
- Photograph
May supplement other voucher types
Often, the only available voucher material if the specimen is
 - Still living
 - Not preserved
 - Entirely consumed for DNA extraction
- Diagnostic DNA sequence(s)
May “collect backwards” starting with published sequences

Tissue Sampling and Preservation for Genomic Collections

General considerations

- High quality DNA (high molecular weight)
- DNA yield
- Minimizing contamination from other DNA sources
- Minimizing DNA damage
 - Enzymatic degradation
 - Chemical damage (cross-linking, acid hydrolysis, free radicals)
 - Radiation (UV, X-rays)
- Practical concerns (safety, shipping, storage, cost)



Tissue Sampling

Choosing tissue types

- Avoid:
 - Tissues likely to contain foreign DNA (e.g., gut, mouth)
 - Digestive tissues (rich in enzymes)
 - Tough structural tissues (few living cells, so low DNA yield)
- Frequently sampled tissues at OGL: muscle, fin, gill, blood
- Non-lethal options and accommodating display/educational needs
- Ideally, multiple tissues per individual (backup, yield, scientific needs)

Tissue Sampling

Choosing tissue types

- Avoid:
 - Tissues likely to contain foreign DNA (e.g., gut, mouth)
 - Digestive tissues (rich in enzymes)
 - Tough structural tissues (few living cells, so low DNA yield)
- Frequently sampled tissues at OGL: muscle, fin, gill, blood
- Non-lethal options and accommodating display/educational needs
- Ideally, multiple tissues per individual (backup, yield, scientific needs)

Amount

- Most organisms: 50 – 1,000 mg of tissue (estimate “pea-sized”)
- Small organisms (<100 mg): entire organism

Tissue Sampling

Choosing tissue types

- Avoid:
 - Tissues likely to contain foreign DNA (e.g., gut, mouth)
 - Digestive tissues (rich in enzymes)
 - Tough structural tissues (few living cells, so low DNA yield)
- Frequently sampled tissues at OGL: muscle, fin, gill, blood
- Non-lethal options and accommodating display/educational needs
- Ideally, multiple tissues per individual (backup, yield, scientific needs)

Amount

- Most organisms: 50 – 1,000 mg of tissue (estimate “pea-sized”)
- Small organisms (<100 mg): entire organism

Preparation

- Maximize surface area that is exposed to preservative

Tissue Preservation

Initial preservation

- Liquid nitrogen
 - “Gold standard” but rarely convenient
- Ethanol
 - Flammability and shipping; not ideal for long term
- Formalin = **bad!** (even for initial fixation)
- “OGLFix v2”
 - Non-flammable; no special shipping restrictions



Tissue Preservation

Initial preservation

- Liquid nitrogen
 - “Gold standard” but rarely convenient
- Ethanol
 - Flammability and shipping; not ideal for long term
- Formalin = **bad!** (even for initial fixation)
- “OGLFix v2”
 - Non-flammable; no special shipping restrictions



Long-term preservation

- Liquid nitrogen
 - 180 °C slows degradation for years/decades
 - Keeps tissue vitrified, below glass transition temperature of water (-132 °C)
 - Minimizes formation of damaging ice crystals
- Avoid freeze-thaw cycles



Organism, Tissue, and DNA Records

Organism → Tissue → DNA

Organism, Tissue, and DNA Records

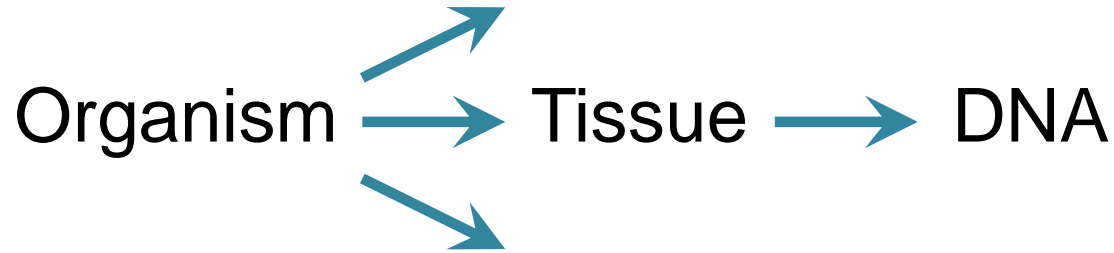
Taxonomy
Voucher
material
Locations
Collection
events
Permits



Sequences
Bioinformatic
s
Assay
results

Organism, Tissue, and DNA Records

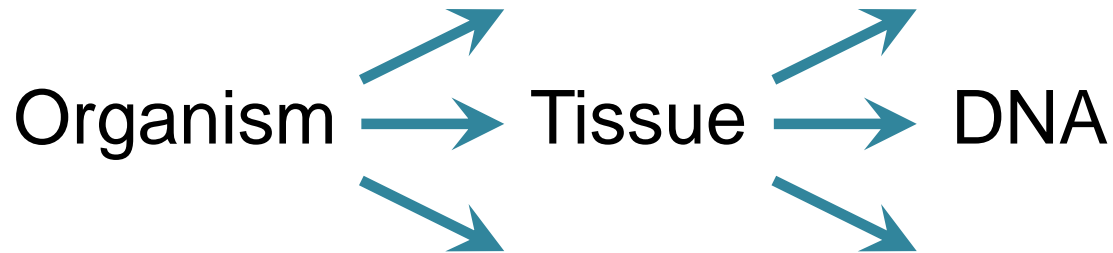
Taxonomy
Voucher
material
Locations
Collection
events
Permits



Sequences
Bioinformatic
s
Assay
results

Organism, Tissue, and DNA Records

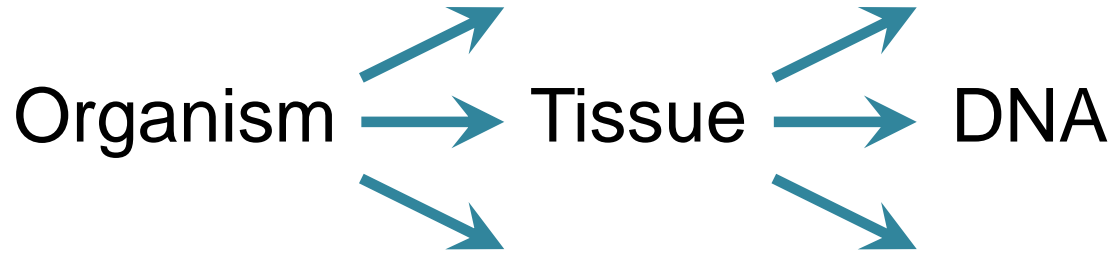
Taxonomy
Voucher
material
Locations
Collection
events
Permits



Sequences
Bioinformatic
s
Assay
results

Organism, Tissue, and DNA Records

Taxonomy
Voucher
material
Locations
Collection
events
Permits

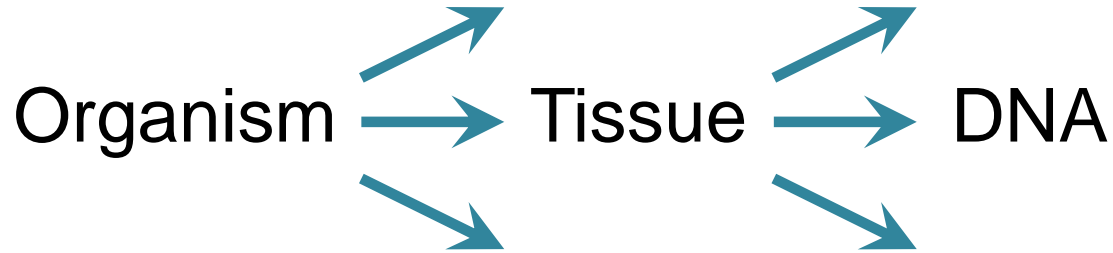


Sequences
Bioinformatic
s
Assay
results

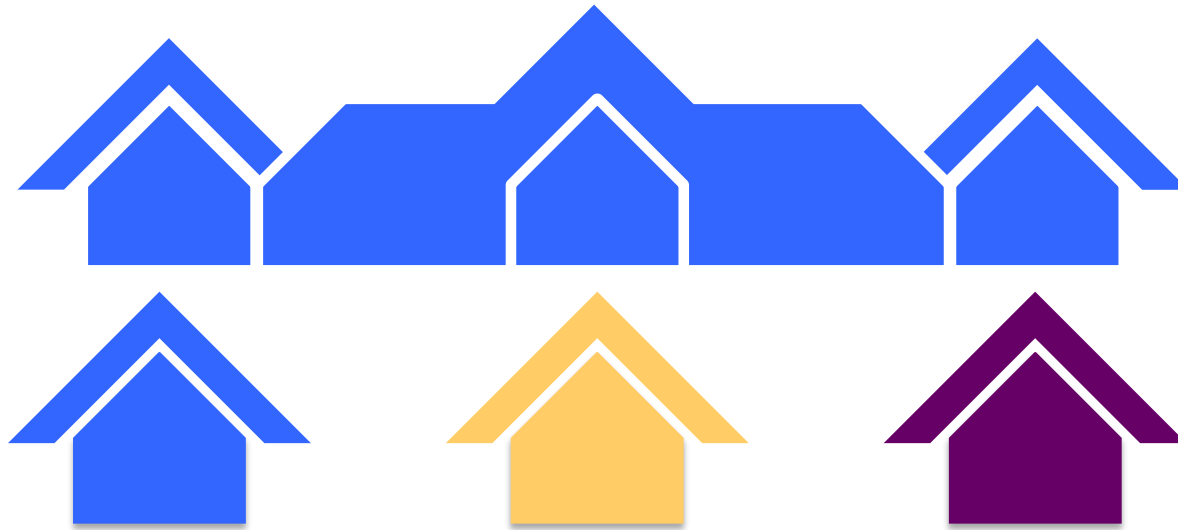


Organism, Tissue, and DNA Records

Taxonomy
Voucher
material
Locations
Collection
events
Permits

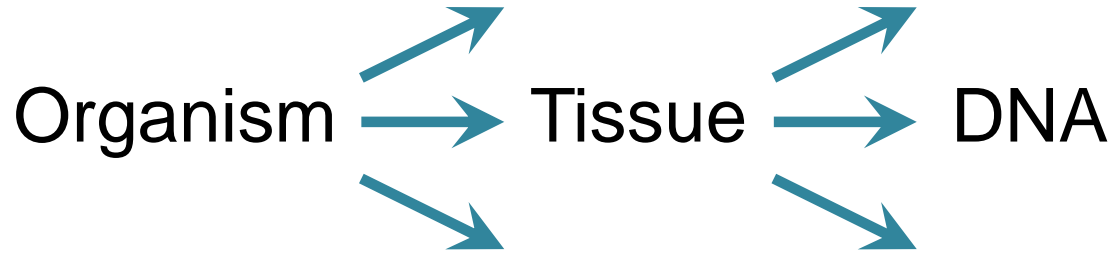


Sequences
Bioinformatic
s
Assay
results

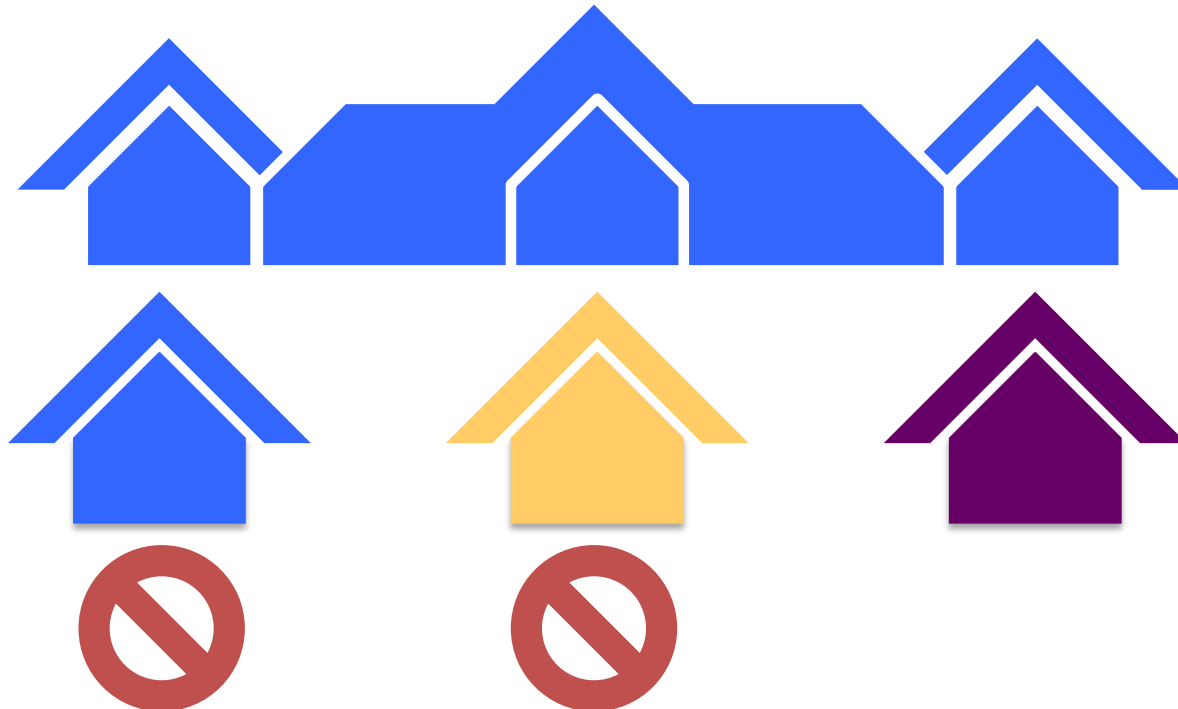


Organism, Tissue, and DNA Records

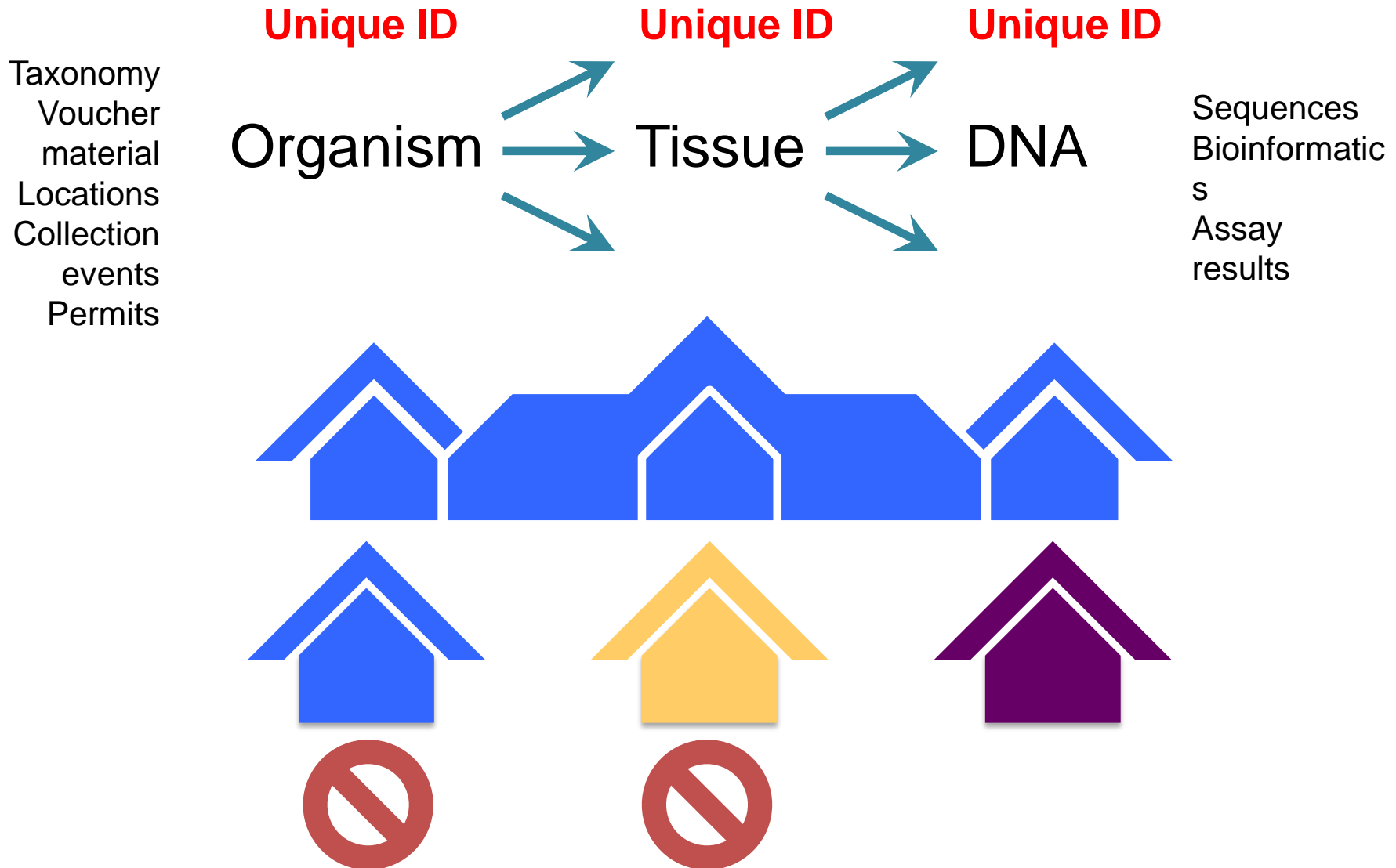
Taxonomy
Voucher
material
Locations
Collection
events
Permits



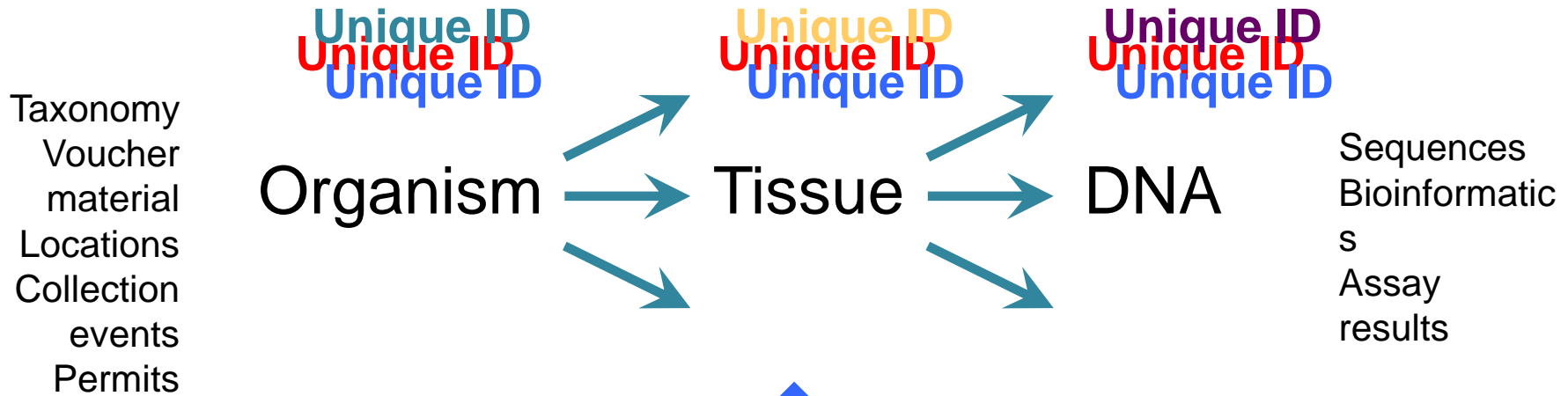
Sequences
Bioinformatic
s
Assay
results



Organism, Tissue, and DNA Records



Organism, Tissue, and DNA Records



Tissue Records

Key Data

Identity

Unique ID

Unique ID of source organism

Can be important tissue-specific differences in DNA modifications or sequences

Source

Sampling method, details

Date of sampling

Initial preservation

Relationship to source organism and voucher
(same individual, same lot, same population?)

Tissue Records

Key Data

Identity	Unique ID Unique ID of source organism <i>Can be important tissue-specific differences in DNA modifications or sequences</i>
Source	Sampling method, details Date of sampling Initial preservation Relationship to source organism and voucher (same individual, same lot, same population?)
Properties	Tissue type Weight, volume
Storage	Preservative Temperature Holding institution(s), aliases

DNA Records

Key Data

Identity

Unique ID

Unique ID of source tissue

Can be important tissue-specific differences in DNA modifications or sequences

Source

Extraction method, details

Date of extraction

DNA Records

Key Data

Identity	Unique ID Unique ID of source tissue <i>Can be important tissue-specific differences in DNA modifications or sequences</i>
Source	Extraction method, details Date of extraction
Properties	Concentration, volume, yield Purity (absorbance ratios) Molecular weight Presence of inhibitors
Assays	Assay type (spectrophotometry, fluorescence, gel) Date of assay
Storage	Preservative Temperature Holding institution(s), aliases

DNA Records

Key Data

Identity

Unique ID

Unique ID of source tissue

Can be important tissue-specific differences in DNA modifications or sequences

Source

Extraction method, details

Date of extraction

Properties

Concentration, volume, yield

Purity (absorbance ratios)

Molecular weight

Presence of inhibitors

Assays

Assay type (spectrophotometry, fluorescence, gel)

Date of assay

Storage

Preservative

Temperature

Holding institution(s), aliases

Sequences?

Link to records in existing bioinformatics repositories

The Great Bioinformatics Beyond...

DNA sequences vs. samples

- Sequence/information repositories
 - Excellent public databases available (e.g., NCBI, BOLD)
 - Distinct from genomic sample repositories
- Important to link bioinformatics data to genomic samples (and consequently to tissues and vouchers)

The Great Bioinformatics Beyond...

DNA sequences vs. samples

- Sequence/information repositories
 - Excellent public databases available (e.g., NCBI, BOLD)
 - Distinct from genomic sample repositories
- Important to link bioinformatics data to genomic samples (and consequently to tissues and vouchers)

Examples of bioinformatics data

- DNA sequences
- Annotations
- Sequencing metadata
- Metagenomics, epigenomics

New Directions

*Natural History
Collections*

*Genomic
Collections*

Research collaborations

Sample exchange

Vouchering specimens from genomic
research

Genomic sampling of natural history
collections

Sharing data and standards

“Mirrored” genomic collections

...



Northeastern University
*The Ocean Genome Legacy Center
of New England Biolabs*

Thank you!

Further questions for OGL?

<http://www.neu.edu/ogl>
c.seid@neu.edu