Using Digitized Data From Insect Collections

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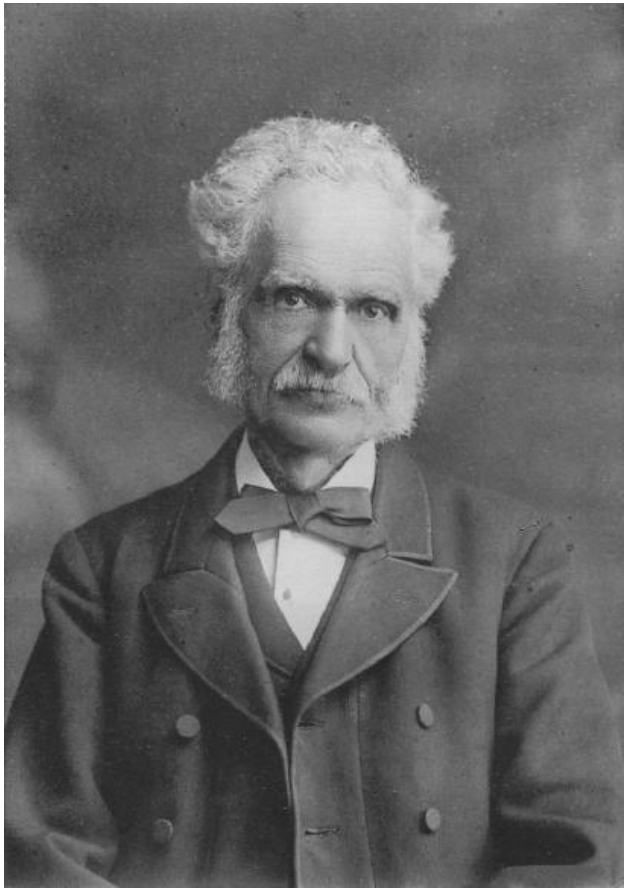
"The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased, and not impaired, in value."

- Theodore Roosevelt, *Speech before the Colorado Live Stock Association, Denver, Colorado, August 19, 1910*

"I am quite convinced that Insects offer better or clearer illustrations of the problems you occupy yourself with than any other class of animals or plants. It is so easy with them to obtain great series of examples and have them before you in a small compass, which is one advantage they have."

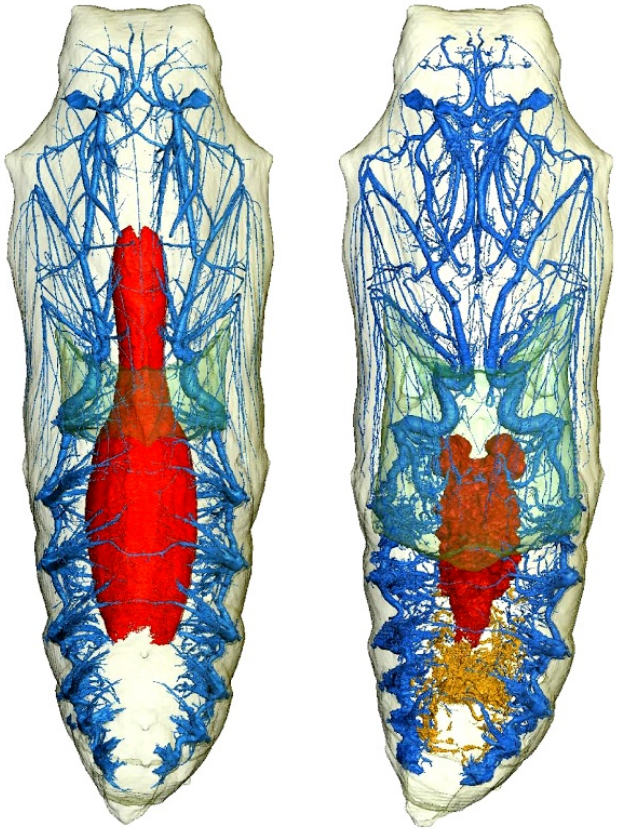


- H.W. Bates, in letter to C.R. Darwin (1861)
http://www.darwinproject.ac.uk/entry-3104

Metamorphosis revealed: time-lapse three-dimensional imaging inside a living chrysalis

Tristan Lowe, Russell J. Garwood, Thomas J. Simonsen, Robert S. Bradley and Philip J. Withers

J. R. Soc. Interface 2013 **10**, 20130304, published 15 May 2013

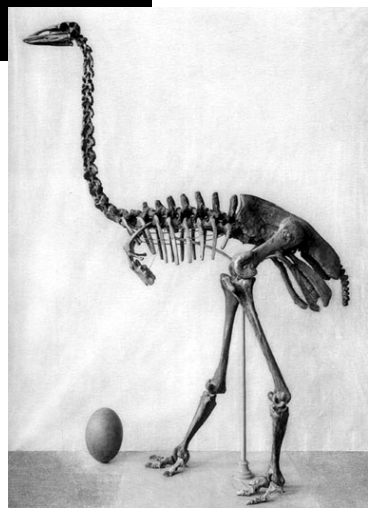


http://www.livescience.com/

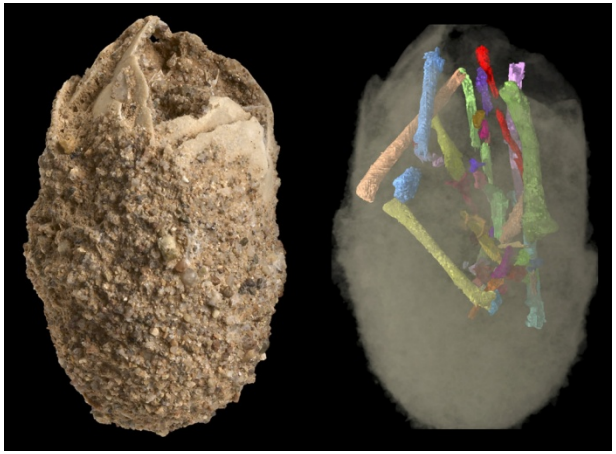
Vanessa cardui pupa

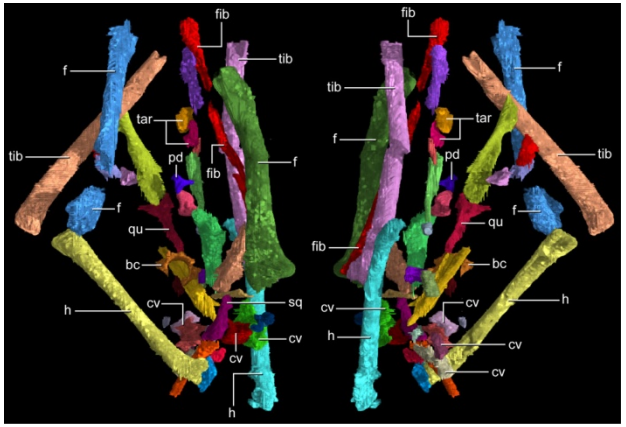
Digitized Specimen Data

Life size printout of bone from elephant bird embryo



Neoceratopsian dinosaur egg/embryo

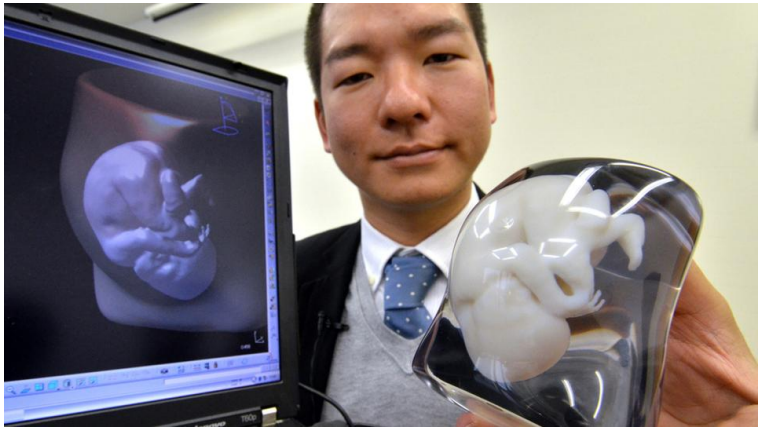




http://www.digimorph.org/

Digitized Specimen Data

- Digital (i.e. non-destructive) dissection
- Quanitfy complex morphological variation morphology
- 3-D printers: digital specimen loan



http://www.bbc.com/future/story/20130514-weird-wild-world-of-3d-printing

Quantifying Use of Digitized Data

- Publications
- Grants
- Log Books

- Downloads
- Impressions
- Search Hits
- Page Views
- Google Analytics
- Data Visualization Tools

Digitized (Specimen) Data

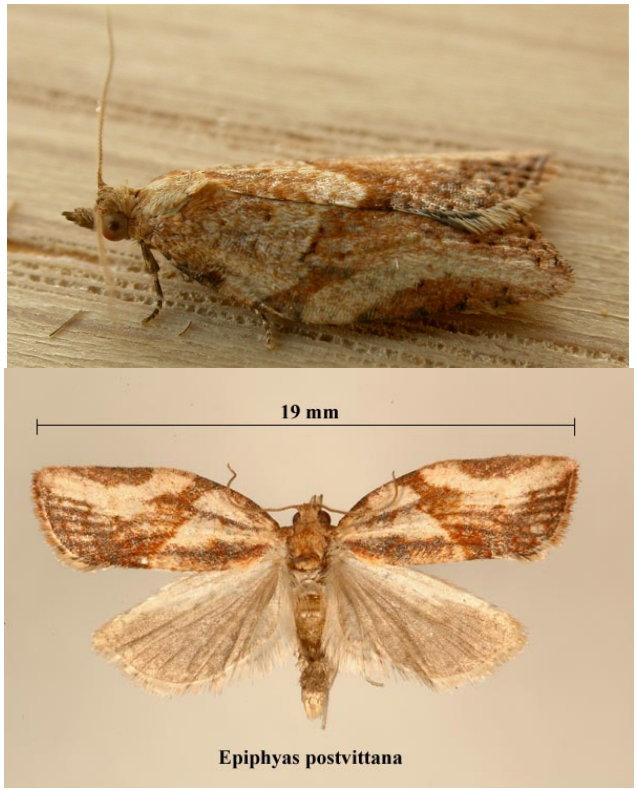
- Images
  - Entire specimens or subsets
  - Labels
- Video/Sound
- Text/Marked up data
  - Transcribed labels
  - Populated databases
- “Children”
  - Tissues
  - Skeleton
  - Skins
  - Nests

- Results/Data
  - Sequences, transcriptomes
  - Measurements
  - Phylogenetic Matrices
  - Phylogenetic Trees
  - CT scans
  - Publications

Historical Uses of Collections

- Examine specimens for taxonomic and phylogenetic study
- Reference for identification
- Document spatial occurrence
  - Arrivals of invasives
  - Extinction
  - Range changes
- Test hypotheses of evolution
- Preserve record of biodiversity
- Deposit vouchers
- Ecological study?
  - Community ecology
  - Interactions
  - Change over time
- Outreach
- Education

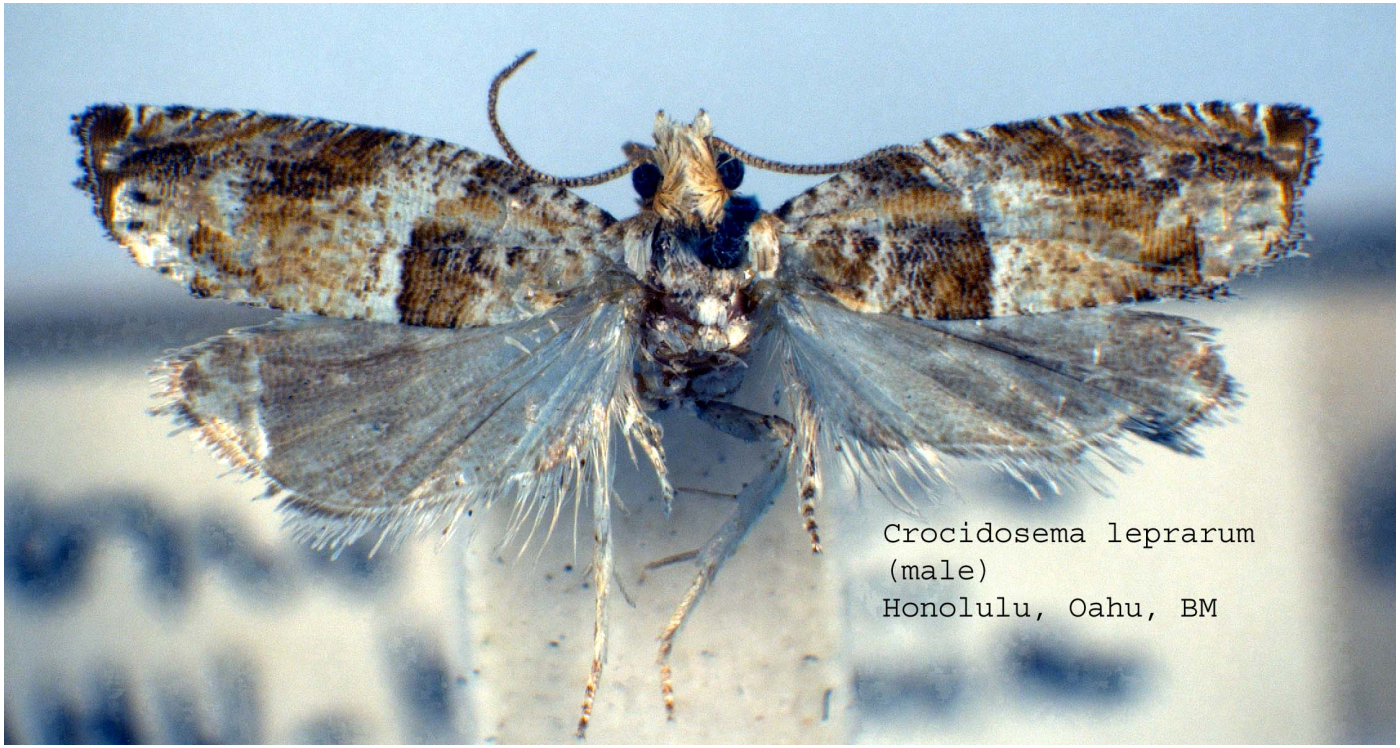
UHIM demonstrates eradication of invasive pest



Epiphyas postvittana, Light Brown Apple moth introduced 1890's, nearly gone from Oahu in 2008

UHIM demonstrates extinction of endemic species

Crocidosema leprarum (Tortricidae): not seen since 1950's



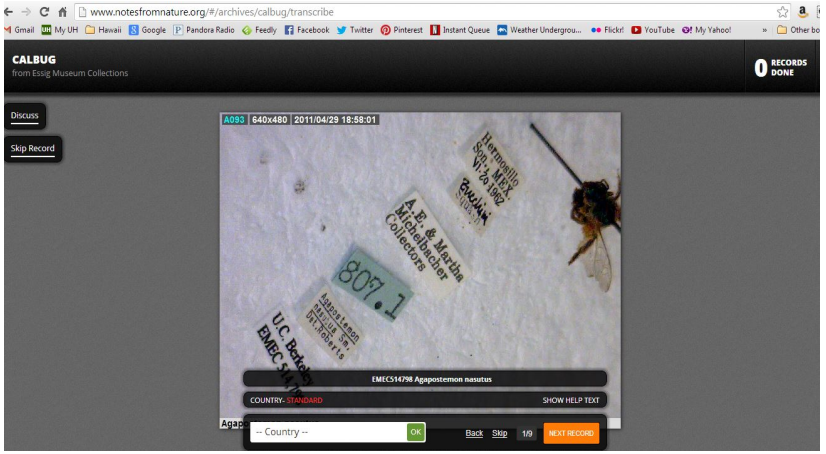
“Citizen Science”

http://www.ctahr.hawaii.edu/pulelehua/

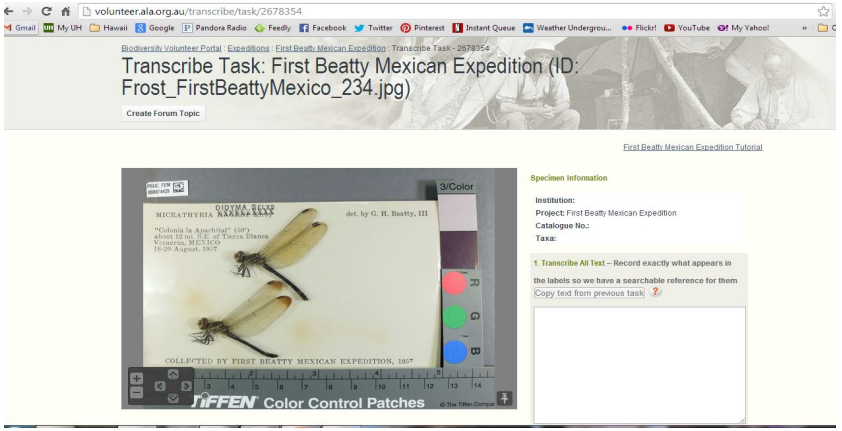
- State Insect: *Vanessa tamehameha* (Kamehameha Butterfly; Pulelehua)
- Users submit photos and location to website
- Researchers verify record and investigate habitat
- Part of larger project
  - Identify critical habitat
  - Identify natural enemies
  - Plant host *Pipturus albidus* (māmaki)

“Crowdsourcing” Biodiversity

- Attempt to circumvent bottleneck problems with “traditional” transcription
- Recruit remote volunteers to transcribe via web interfaces and images



Notes From Nature



Atlas of Living Australia

Limitations of Crowdsourcing

- Oversaturation of "market" (*it is going to get worse!*)
  - Everyone is asking for funding or work
  - Many efforts are deserving
  - Biodiversity research is not special to the average person
- Limited value in casual contributors
- Lack adequate recruiting efforts
  - Promotion
  - Motivation
- Lack incentive
- Lack personalized, interactive tutorials or support

Uses of Digitized Data for…

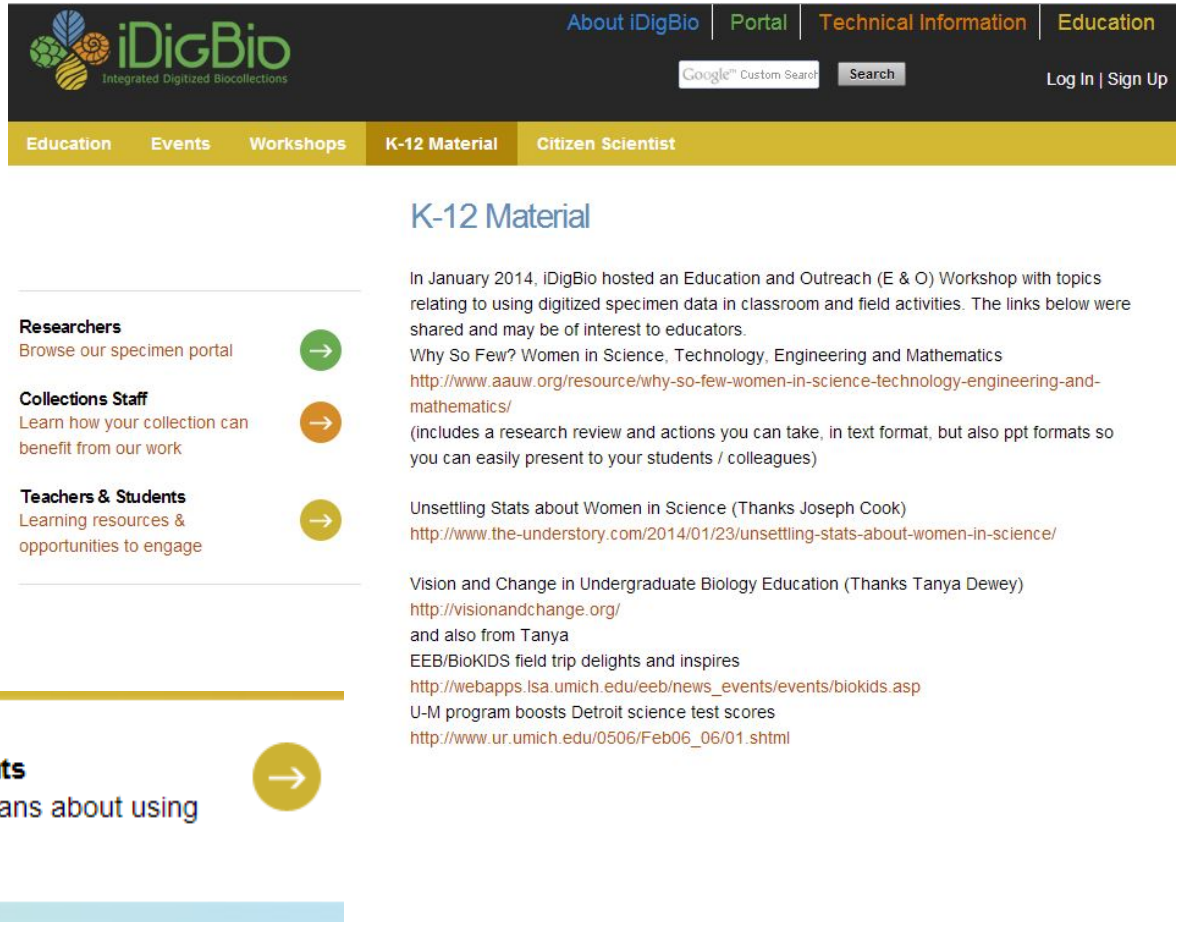
- Outreach
  - Public displays
  - Tours
  - “one off” educational experiences
- Education
  - Courses, laboratories, etc.
  - “formal” education
  - Captive audience

Collections and Education

- Get people excited about biodiversity
- Examine/handle specimens
  - Taxonomic diversity
  - Morphological diversity

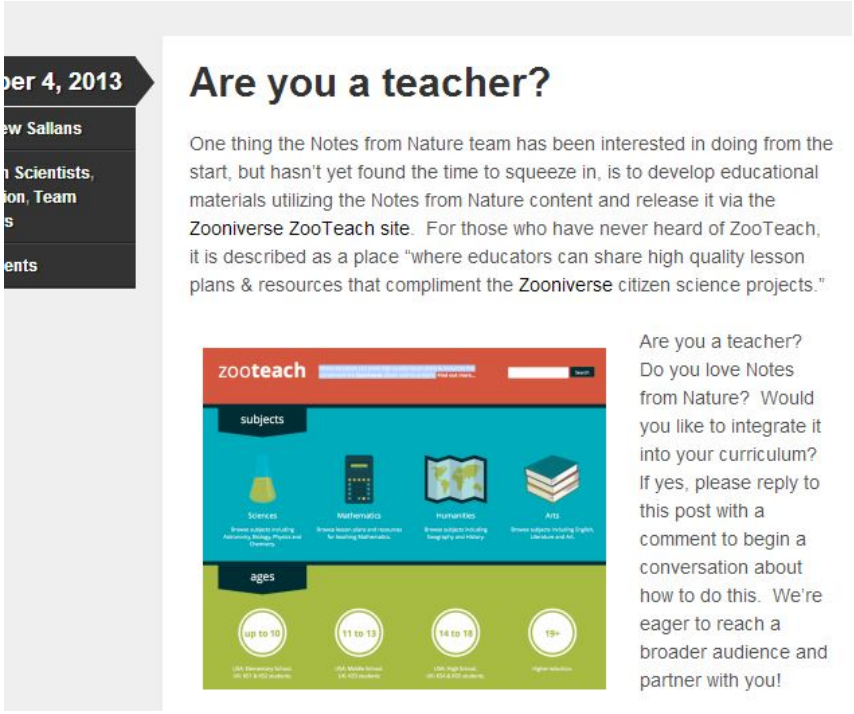
Developing Educational Resources

- External links to blogs and news stories
- No original content
- Nothing useable in a classroom

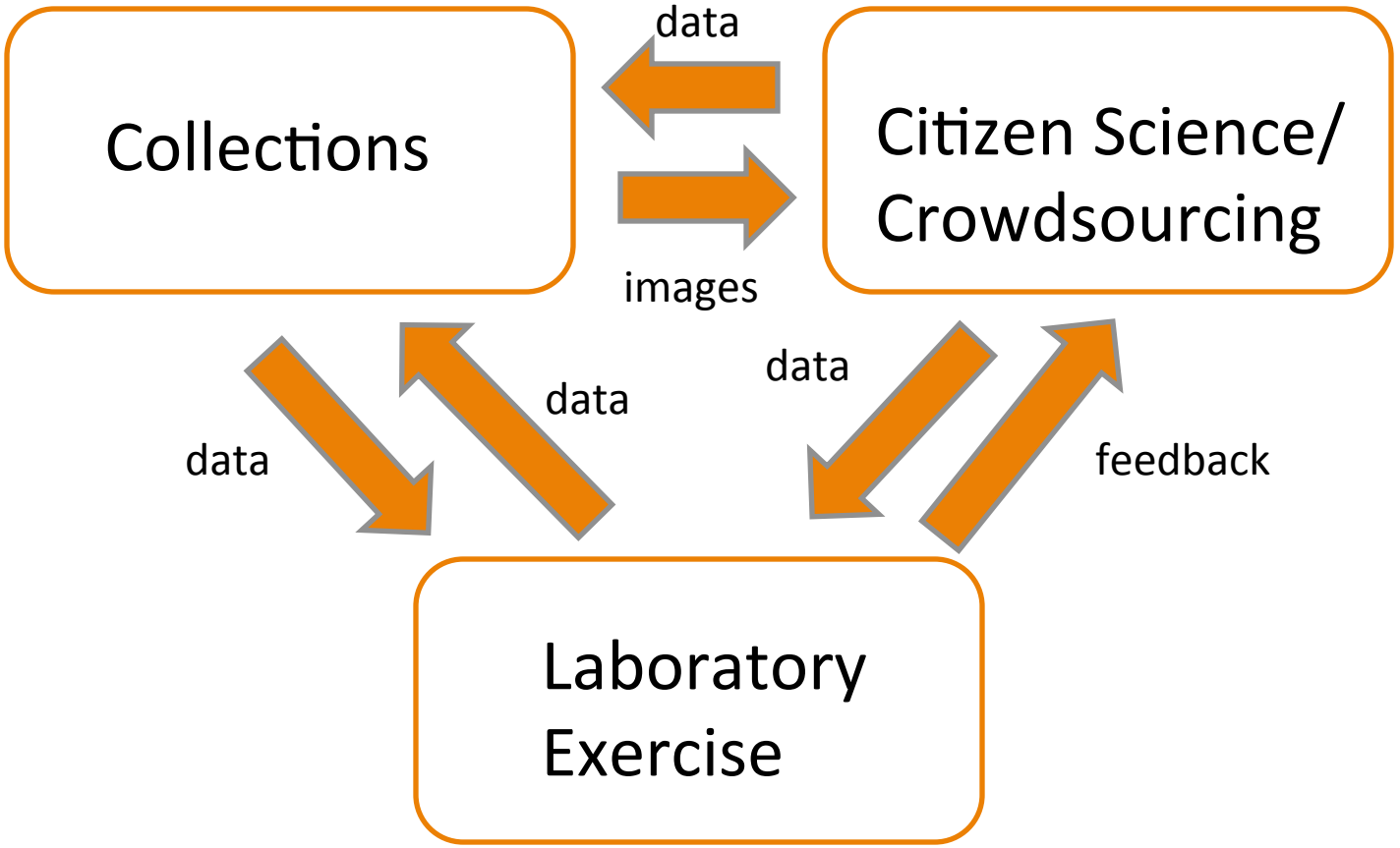


Developing Educational Resources

- Typical instructors lack knowledge of what biodiversity data is and how to use it
- Content providers must collaborate with educators



http://blog.notesfromnature.org/2013/10/04/are-you-a-teacher-2/


Collections
data
Citizen Science/
Crowdsourcing
images
data
data
data
feedback
Laboratory
Exercise

Incentivizing Digitization Efforts with grades

- Appropriate for grade level 6? And up
- Good for home school curriculum
- Simple transcription assignments (students experience data collection)
- Laboratory exercises
- Research projects

Developing Educational Resources

- Coordinate efforts *directly* with instructors
- Match lessons to state BOE curriculum standards, learning outcomes, etc.
- Modify according to various pedagogical trends
  - Inquiry based, etc.
- Check Institutional Review Board to see if approval is needed for use of Human Subjects
- Connect *locally*

Biology 114 Learning Outcomes: Evolution

- Successful students will be able to explain the mechanisms of microevolution.
- Successful students will be able to use concepts associated with microevolution and macroevolution to explain patterns of speciation and extinction.
- Successful students will be able to explain mechanisms of sexual selection and the evolution of social behavior.
- Successful students will be able to describe methods used to infer evolutionary relationships.
- Successful students will be able to explain the relationship between evolutionary hypotheses and the biological classification system.
- Successful students will be able to use the geologic time scale to identify when major biological evolutionary events occurred.

Biology 114 Learning Outcomes: Population and community ecology

- Successful students will be able to explain ecological phenomena related to populations and communities in terms of basic mathematical models.
- Successful students will be able to trace chemicals and energy through an ecosystem to explain human and global impacts of perturbations.
- Successful students will be able to describe the interrelationship between biodiversity and community interactions, such as such as predation, competition, and symbiosis.

Conclusions

- Digitization adds value to specimens & collections
- Value of specimens and digitized specimen data depends on its use
- We need to develop innovative educational uses for digitized data
- We need to demonstrate value in new ways

Mahalo!

- Gil Nelson and iDigBio
- NSF DEB: Collections in Support of Biological Research (CSBR)
- Dan Rubinoff (UHIM Director)
- UHIM Staff: Will Haines, Luc Leblanc, Mike San Jose, Andersonn Prestes

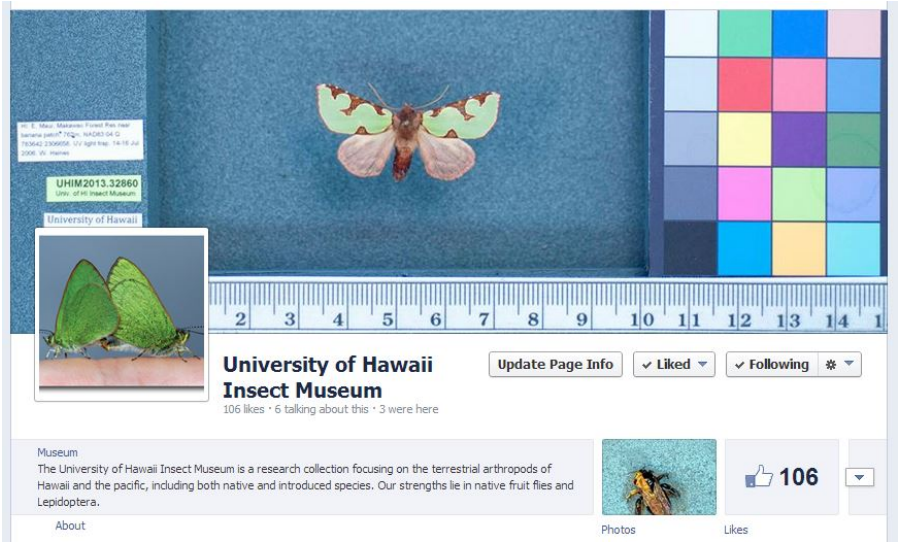
iDigBio
Integrated Digitized Biocollections

invertnet

NSF

Web & Social Media Presence

- Goals
  - connect with local citizens and spread awareness of the UHIM mission
  - Update followers on research
  - Conduit for crowdsourcing efforts between citizen scientists and UHIM staff



Web: ctahr.hawaii.edu/insectmuseum/

Facebook: facebook.com/UHinsectmuseum

Blog: uhawaiiinsectmuseum.wordpress.com/

Flickr: flickr.com/photos/uhmuseum/