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# Designing Instruction Activities to Guide Students Through the Research Lifecycle: A Science Librarian Approach

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## Designing Instruction Activities to Guide Students through the Research Lifecycle

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Collection Research Focused

Informaition Literacy

"Research Literacy" InformationLiteracy
Research Methodology
Data Literacy
Laboratory Safety
Ethics

.....

\* Trends in Instructions Provided by Librarians in Research Institutions





### \* Trends in Instructions Provided by Librarians in Research Institutions



#### \*Teaching and Learning Environment

Curriculum-centric content delivery



\*Research Environment

Working on a highly-focused topic in isolation



learning

Active Creative Peer-to-peer support

Content generating Research component Group work project-based engaging

**Collaborative** Data-intensive Interdisciplinary Multidisciplinary

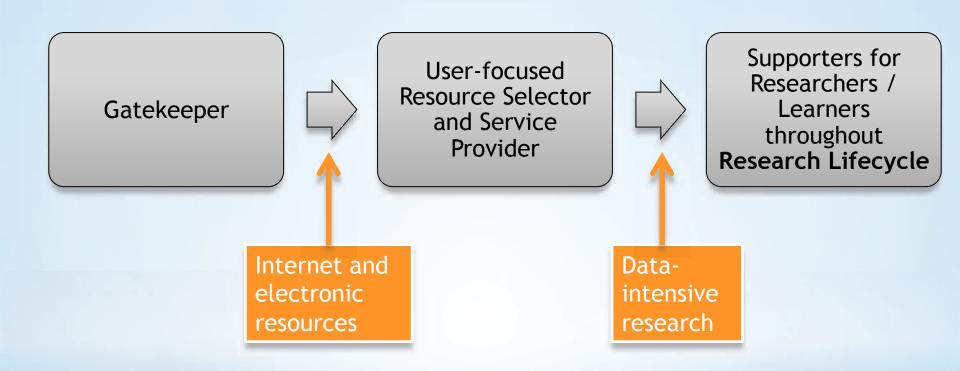
Changing Environment in Higher Education

**ACS 246th National Meeting** 

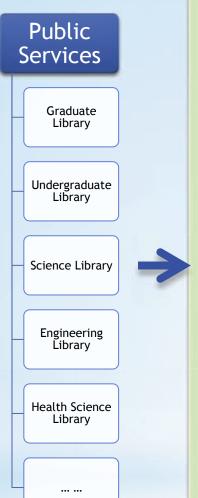
A. Brewerton, New Review of Academic Librarianship 2012, 18 (1), 96-110.

doi:10.1080/13614533.2012.665718





## \* Evolving Role of Subject Specialists





#### Teaching and Research Learning Arts & Humanities

International

**Studies** 

Social

Sciences

Asia Library

Science,

Engineering & Data

User Info & Discovery Services

**Technology** Integration

Learning Program & Initiatives

**Technology** Group

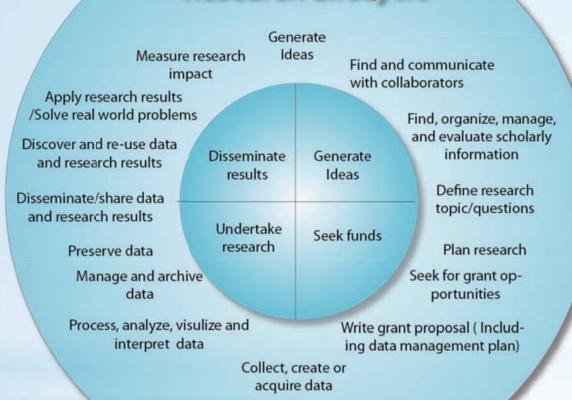
Digital Media Commons University of Michigan

Subject specialists focuses more on supporting RESEARCH

### \*Local Change - University of Michigan Library Reorganization \*



#### Research Lifecycle



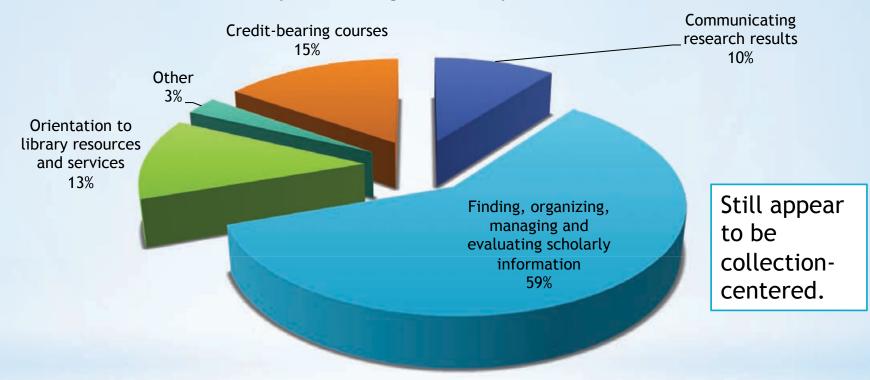
- \* All steps involve obtaining, digesting, managing, synthesizing, and disseminating information
- \*Librarians are good at connecting resources and people together

We can contribute to each step before and after lab!

\* Research Lifecycle

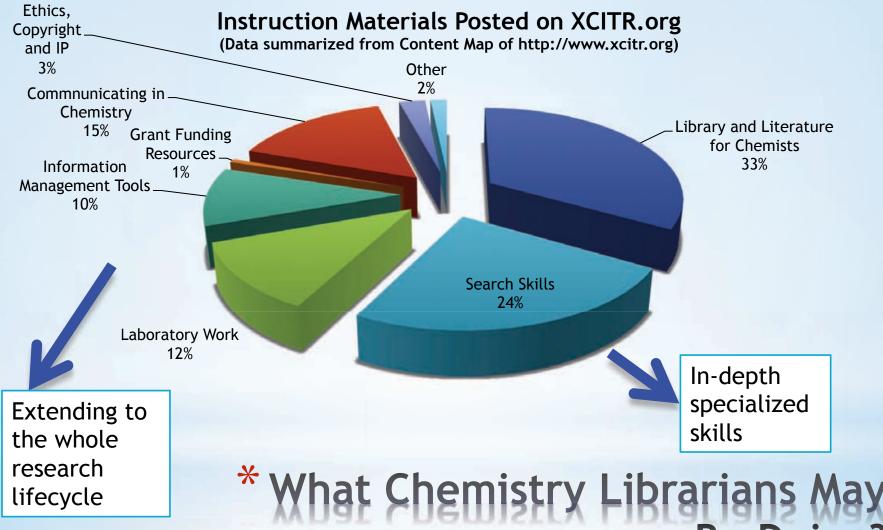


### Instructions Delivered by Science and Engineering Librarians at University of Michigan Library in 2012 - 2013



## \*Types of Instructions from Sci & Engin Librarians at the Univ. of Michigan







- \*Focusing on this step "Find, manage, organize, and evaluate scholarly information"
  - \*In-depth/advanced searching skills
  - \*Critically evaluating information
- \*Extending to other steps of the research lifecycle

### \* Current Focus in Instruction



#### \*Undergraduate Student

"I participated in UROP (Undergraduate Research Opportunity Program) during my first year here. Although I was super busy in the lab, I didn't think I learned how to do research. I still have no idea how to approach a new research project."

#### \*Graduate Student

"I know how to obtain 'good enough' articles quickly. Is there anything else I need to learn (from you)?"

"I've read ten articles on this topic, but how am I supposed to come up with an original proposal from them? I can't discuss this with my advisor."

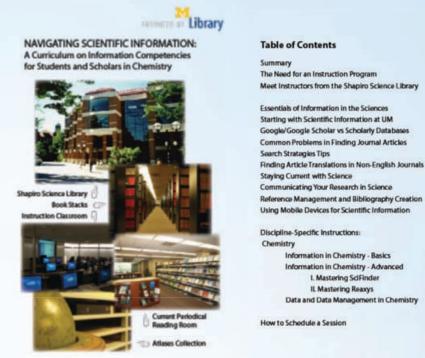
Gaps between learning knowledge/skills and applying the knowledge/skills into research need to be filled.

## \* What Students Have to Say?



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- \*Most popular sessions requested by instructors
  - \*Scientific Writing and Presenting Your Research Results
  - \*Wikipedia Editing
- \*Basic search skills mostly requested as customized online tutorials and office hours
- \*Advanced search skills occasionally requested

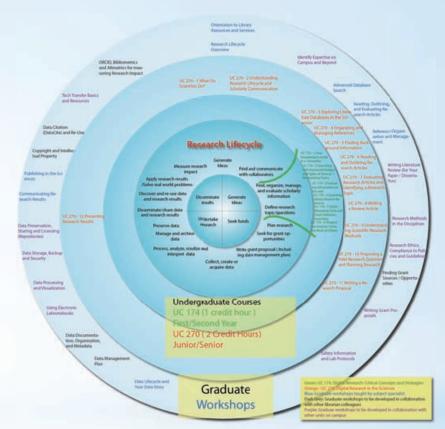


Going in-depth with finding information is important but we also need to explore the breadth of our instruction scope.





- \*Mapping instruction activities to the RLC can guide librarians to identify
  - \*Gaps in supporting research
  - \*Opportunities to collaborate with other librarian colleagues and other units on campus for instruction development.



\* Mapping Current Instructions to RLC



## \*For Undergraduates

A basic for-credit course is in place. Needs to develop an advanced level course.



Course	UC 174: Digital Research: Critical Concepts and Strategies
Audience	First- and second-year undergraduates
Credit	1 Credit Hour
Length	2 hours / week, 7 weeks
Focus	Basics of "finding, organizing, managing and evaluating scholarly information"
Final project	An annotated bibliography on the topic selected by the student
Participation	~100 undergraduates / year ; ~30 in Sciences

# \*Overview of UC 174 - A basic level library research course



#### **Research Lifecycle**

Generate

Disseminate

results

Undertake

research

Measure research impact

Find and communicate with collaborators

Find, organize,

manage, and evaluate

scholarly information

Define research

topic/questions

Plan research

Seek for grant op-

portunities

Apply research results
/Solve real world problems

Discover and re-use data and research results

Disseminate/share data and research results

Preserve data

Manage and archive data

Process, analyze, visulize and interpret data

Write grant proposal (Including data management plan)
Collect, create or

Generate

Ideas

Seek funds

UC 174 - 1 How Knowledge is Made in a University

UC 174 - 2 Searching with Keywords / Subject and Types of Sources + Formulating Topics

UC 174 - 3 Evaluating information on the web
UC 174 - 4 Searching Library Resources
UC 174 - 5 Styles,
Managing Tools
and Cited-reference
Searching
UC 174 - 6 Integrating Sources:
Using the Work of
Others

To design another advanced level course for students in the Sciences

- Go in-depth? or
- Extend to other steps of RLC?

**Undergraduate Courses** 

UC 174 (1 credit hour ) First/Second Year

acquire data

Topic Covered in UC 174

		LIUIT,
Course	UC 174: Digital Research: Critical Concepts and Strategies	UC 270: Digital Research in the Sciences
Audience	First- and second-year undergraduates	Junior and senior undergraduates
Credit	1 Credit Hour	2 Credit Hours
Length	2 hours / week, 7 weeks	2 hours / week, 12 weeks
Focus	Basics of "finding, organizing, managing and evaluating scholarly information"	Expanding the "basics" and Extending to "write a research proposal / presenting research"
Final project	An annotated bibliography on the topic selected by the student	A mini literature review and a mini research proposal
Participat ion	~100 undergraduates / year; ~30 in Sciences	A trial in 2013

\*Overview of UC 270 
ACS 246th National Meetin An advanced Tevel research course

UC 270 - 1 What Do Scientists Do?

UC 270 - 2 Understanding Research Lifecycle and Scholarly Communication



#### Research Lifecycle

Generate

Ideas

Measure research impact Apply research results

Find and communicate with collaborators

Discover and re-use data and research results

/Solve real world problems

Preserve data

Manage and archive

data

Disseminate results

research

manage, and evaluate scholarly information Generate Ideas

Disseminate/share data and research results Undertake

topic/questions Seek funds

Plan research Seek for grant opportunities

Find, organize,

Define research

Process, analyze, visulize and interpret data

Write grant proposal (Including data management

Collect, create or acquire data

UC 270 - 3 Exploring Literature Databases in the

> UC 270 - 4 Organizing and Managing References

UC 270 - 5 Finding Background Information UC 174-1 How

Knowledge is Made in a University

UC 174 - 2 Searching with Keywords / Subject and Types of Sources + **Formulating Topics** 

UC 174 - 3 Evaluating information on the web UC 174 - 4 Searching Library Resarch Resources UC 174 - 5 Styles,

**Managing Tools** 

Searching UC 174 - 6 Integrating Sources: Using the Work of Others

and Cited-reference UC 270 - 9 Understanding Scientific Research Methods

UC 270 - 6 Reading

and Outlining Re-

UC 270 - 7 Evaluating

Research Articles and

UC 270 - 8 Writing

a Review Article

Identifying a Re-

search Topic

search Articles

C 270 - 10 Proposing a /alid Research Question and Planning Research

270 - 11 Writing a Reearch Proposal

#### **Undergraduate Courses**

UC 174 (1 credit hour) First/Second Year UC 270 (2 Credit Hours) Junior/Senior

Pesign of UC 270

UC 270 - 12 Presenting

Research Results



Understand RLC and Scholarly Communication Identify and organize large sets of reference for a interested research direction

Find background information to help digest the references

Read, outline and evaluate articles selected from the large set

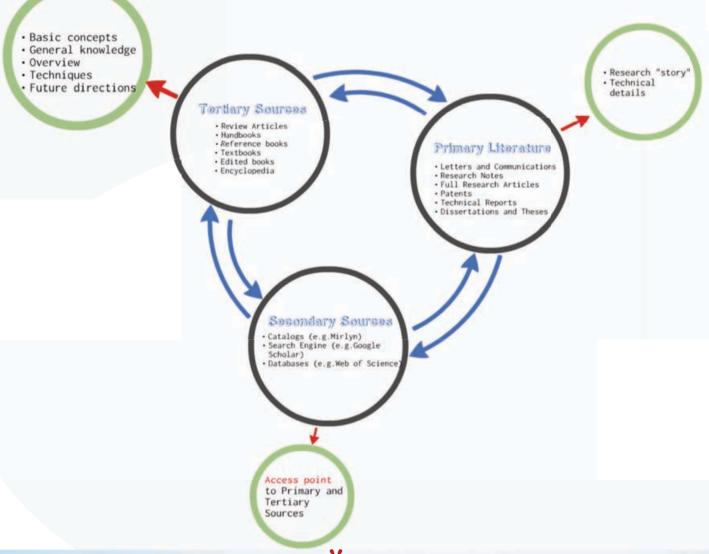
Identify a research topic based on the readings

Write a minireview on the selected research topic Understand research methods and identify valid scientific hypothesis Propose valid research questions and design research plans

Write a miniproposal Present the research proposal and process led to the proposal

- 8 Assignments + 3 Reflections build up to a mini-review, mini-proposal, and an oral presentation
- Depth: practice advanced search skills with the goal to select a research topic
- Breadth: RLC steps beyond finding, organizing, and evaluating information
- Students run demonstrations of databases and software
- In-class discussions on issues in scholarly communication, such as open access and negative citations, etc.





\* Scholarly Publication Types

Research Output Flectronic Lab Notebook University of Michigan Research Records Review articles Textbooks Encyclopedia Text files (Word, TXT, Google Docs etc.) Popular magazines Dictionary Business magazines Spread sheets (Excel, Google Spreedsheets, CSV etc.) Databases Newspaper News websites Images Social network Research Life Cycle Videos · Letters and communications **Emails**  Research notes Instant Message FullI research articles · Emails Generate Conversation Patents · Research blogs Find and communicate Ideas Apply research results Wikis with collaborators · Data depositing to /Solve real world problems Reference mandisciplinary or institu-Find, organize, Data and associtional repositories Discover and re-use data manage, and evaluate agement softated metadata in Disseminate Generate scholarly information and research results ware Ideas results a format com- Group webpages · Technical report · Reports monly usable in Disseminate/share data Define research Comments and Dissertation and Preprints and research results the community topic/questions notes in PDF theses Conference abstracts, Research reports papers, proceedings etc. Undertake Seek funds research Preserve data Write grant Data in various PDF proposal/obtain funding formats associ-Process, analyze, visulize and (GOV, NGO, Industry) ated with various interpret data computing soft-Collect data Raw data in various formats (mostly proprietary)

Resource management files (e.g. cell/mice colony management)

Resource management documents of the colony management of t Research proposals

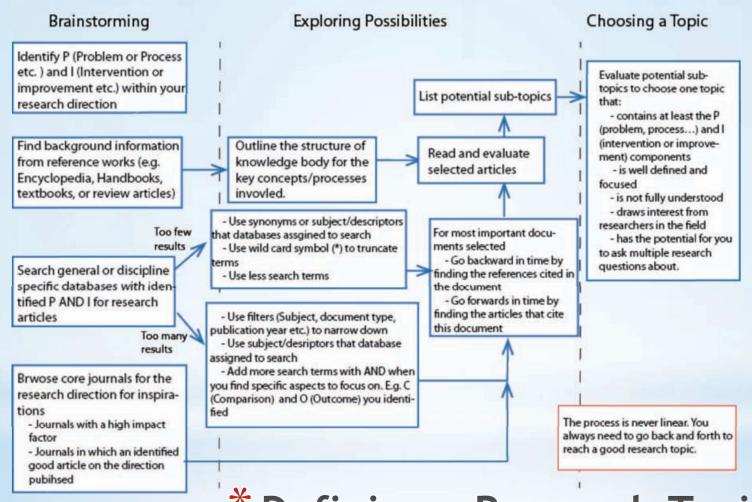
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I Y
n

Major Section	Authors need to explain	Readers need to identify	Readers need to evaluate
Introduction	<ul> <li>What is in the paper?</li> <li>Why is it an interesting and worthwhile issue?</li> <li>Who contributed what previously?</li> </ul>	<ul> <li>What is the subject?</li> <li>What is known?</li> <li>What remains to be known?</li> <li>How or why a certain new question or questions arose?</li> <li>What did the authors do to evaluate and answer the new questions?</li> </ul>	<ul> <li>Background information sufficient?</li> <li>Reasoning logic?</li> <li>Research questions valid? relevant?</li> </ul>
Methods	How did they do the work? (for others to duplicate and confirm)	<ul> <li>Initial facts and assumptions</li> <li>Object, materials, place, instruments, programs, etc. involved.</li> <li>Protocols and methods to obtain/collect and analyze data.</li> </ul>	<ul> <li>Methodology valid? Relevant?</li> <li>Assumptions of the methods valid for the research question?</li> <li>Sampling representative?</li> <li>Well planned and executed?</li> </ul>
Results	What facts are revealed by the work?	<ul> <li>Statement about each findings</li> <li>Multifaceted and complex data</li> <li>Links among data identified by the authors</li> <li>Authors' interpretations</li> </ul>	<ul> <li>Data presented accurate, organized?</li> <li>Facts, opinions, or facts under certain assumptions?</li> <li>Consistent? Logic?         Assumptions reasonable?     </li> </ul>
Discussion	<ul> <li>What do the results mean?</li> <li>What are the answers to the proposed questions?</li> </ul>	<ul> <li>New points illuminated by results</li> <li>How did or did not previous knowledge get changed by new findings?</li> <li>Comparisons with the results of others and discuss the consequences of those comparisons.</li> </ul>	

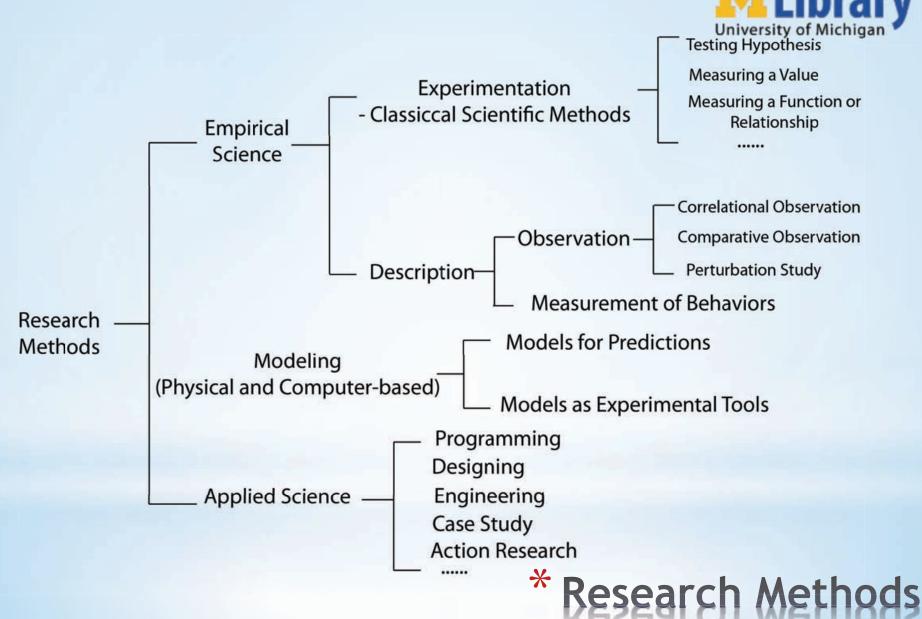




#### Defining a Research Topic from a Vague Research Direction



Defining a Research Topic from a General Research Direction





- \*Students showed initial interests to register for the course (10-15 people registered) but then gave up when semester was about to starts (only 3 students showed up on the first day)
- \*Course trial turned into a guided study
- \*Only one student finished the course
- \*Course load may be more appropriate for 3-credit hours
- \*Instructor may not be able to advise the research topic students selected
  - \*May need to form an instruction team with subject specialists in multiple disciplines

## \* Challenges Identified from the Trial of UC 270



- \*"I really enjoyed taking this class, especially since this class was not like the lecture-style classes that I normally take at engineering school."
- \*"I do think I've benefited a lot from this class, especially for deciding about my future plan in going to graduate school."
- \*(Most valuable things learned from the course?) "Critical Thinking Skills, Especially when I had to design my own research to write the proposal; Reading scholarly journal articles, searching database, writing skills, reviewing articles."

Requested after grades submitted

\* Student Feedback from the Trial of UC 270



- \* "Currently, I am finding the class to be more demanding than a regular 2 credit 200-level course, based on the Mini-review comments you provided. The comments did help me a lot in enhancing my review article writing skills. However, I do not think I will be able to meet the criteria you gave as a feedback if I spend about 6 to 8 hours per week."
- \*"Maybe instead of writing the mini-review, we could have just written informal reviews throughout the semester via blog. For example, every other week, I could read an article, and then write some brief summary about the article and its topic, and make some comments on the articles."

## \* Student Feedback from the Trial of UC 270



\*Do faculty and students view librarians as trusted instructors for research beyond topics directly around finding information?

\*Am I getting too far from our comfortable zone (our specialty)?

\*Did I step on toes ...?

\* Questions Remains...



## \*For Graduate Students

No for-credit courses.

Create workshop series around the Research Lifecycle.

Orientation to Library Resources and Services

Research Lifecycle Overview

Identify Expertise on Campus and Beyond

UC 270 - 3 Exploring Litera

and Outlining Re-

UC 270 - 7 Evaluating

UC 270 - 8 Writing

ing Scientific Research Methods

and Planning Research

70 - 11 Writing a Re-

Library
University of Michigan

Tech Transfer Basics and Resources

UC 270 - 12 Presenting

ORCID, Bibliometrics

and Altmetrics for mea-

suring Research Impact

Data Citation (DataCite) and Re-Use

Copyright and Intellectual Property

Publishing in the Sciences

Communicating Research Results

Data Preservation. Sharing and Licensing

Data Storage, Backup and Security

> Data Processing and Visualization

> > Using Electronic Labnotebooks

> > > Data Documentation, Organization, and Metadata

> > > > Data Management Plan

Data Lifecycle and Your Data Story

ACS 246th National Meeting

#### Research Lifecycle



#### **Undergraduate Courses**

UC 174 (1 credit hour) First/Second Year

UC 270 ( 2 Credit Hours) Junior/Senior

Graduate

Workshops

**Advanced Database** Search

Reading, Outlining, and Evaluating Research Articles

> Reference Organization and Management

> > Writing Literature Review (for Your Paper / Dissertation)

Research Methods in the Disciplines

Research Ethics, Compliance to Policies and Guidelines

**Finding Grant Sources** / Opportunities

Writing Grant Proposals

Safety Information and Lab Protocols

> Green: UC 174: Digital Research: Critical Concepts and Strategies Orange: UC 270: Digital Research in the Sciences Blue: Graduate workshops taught by subject specialist Dark Grey: Graduate workshops to be developed in collaboration with other librarian colleagues

Purple: Graduae workshops to be developed in collaboration with other units on campus



- \*Orientation to Library Resources and Services
- \*Research Lifecycle Overview
- \*Advanced Database Search
- \*Reading, Outlining and Evaluating Research Articles
- \*Reference Organization and Management
- \*Data Literacy Workshop Series
  - \*Data Lifecycle and Your Data Story
- \*Communicating Research Results
- \*Publishing in the Sciences

## \* Workshop Delivered by Subject Specialists

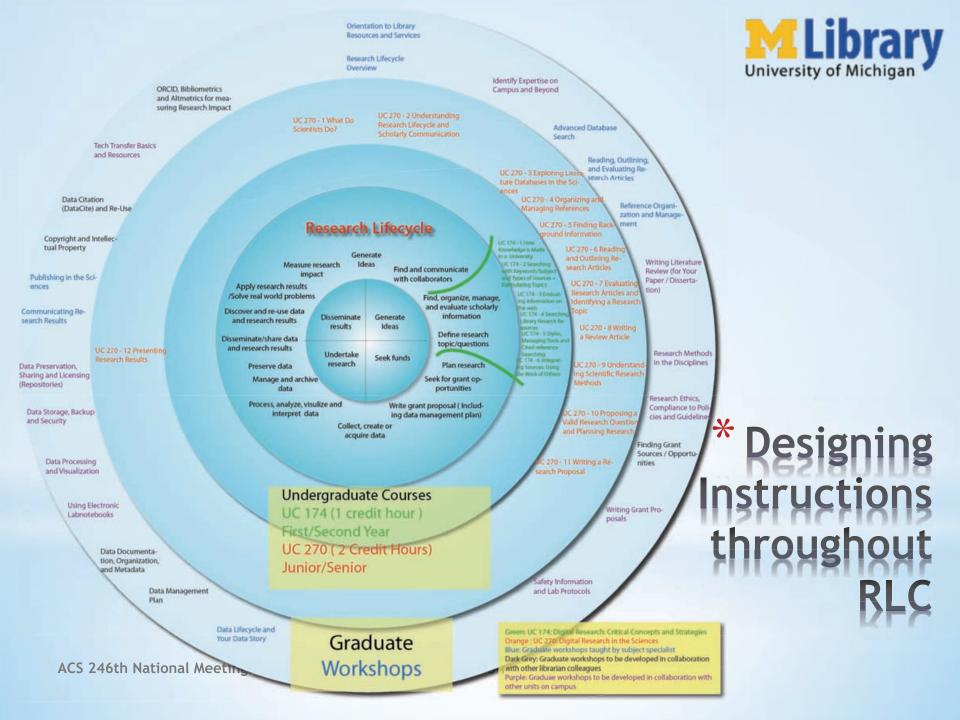


Workshops	To collaborate with
Finding Grant Source/Opportunities	Grant Librarian
Data Management Plan	Data Librarian
Data Documentation, Organization, and Metadata	Data/metadata Librarian
Copyright and Intellectual Property	Copyright Librarian
Data Citation and Re-use	Data Librarian
ORCID, Bibliometrics and Altmetrics for Measuring Research Impact	Data Librarian

# \* Workshops to Collaborate with Other Librarians

Workshops	To Collaborate with	
Identify Expertise on Campus and Beyond	Office of Vice President for Research	
Writing Literature Review (for Your Paper / Dissertation)	Writing Center	
Research Methods in the Disciplines	Faculty	
Research Ethics, Compliance to Policies and Guidelines	Office of Vice President for Research	
Writing Grant Proposal	Writing Center	
Safety Information and Lab Protocols	Lab Safety Officers in Departments	
Using Electronic Lab Notebooks	ITS	
Data Processing and Visualization	ITS, Center for Statistical Computing and Analysis	
Data Storage, Backup and Security	ITS	
Data Preservation, Sharing and Licensing	Institutional Repository	
Tech Transfer Basics and Resources	Tech Transfer	







- \*... the primary goal of Science is not the research output but the people who do science scientists, one generation after another...
- \*... start from deep and profound understanding of the subject matter and collaborate with students to find answers to interesting questions together ...
- \*... work with student collaborators to translate how research is done to how education is done...
- -- Summarized from Prof. Brian Coppola's talk at the 246<sup>th</sup> ACS National Meeting, Indy, IN, September 10, 2013





Designing instructions based on sources/resources in our collection



Designing instructions based on what's needed at each step of the research lifecycle

Continue going in-depth with chemical information literacy skills

Continue extending the breadth further throughout the research lifecycle via collaborations with other librarians and other units

## \* What's Next for Chemistry Librarian?



Designing instructions based on sources/resources in our collection



Designing instructions based on what's needed at each step of the research lifecycle

Continue going in-depth with mical information literacy skills

Continue extending the breather throughout the research lifecycle via collaborations without the librarians and other units

### \* What's Next for Chemistry Librarian?



- \*Thank Doreen Bradley and the UC 174 instruction team at MLibrary for the UC 174 materials and their support to this work
- \*Thank my colleagues, especially members of the Research Lifecycle Committee at MLibrary for inspiring this work
- \*Thank all students participated in the UC 270 trial

\* Acknowledgement



## Thank you!

Did I get carried away and lose the focus on our unique specialty?

Contact Ye Li at <a href="live@umich.edu">live@umich.edu</a>