THE OPEN SCIENCE COOKBOOK

edited by Emily Bongiovanni, Melanie Gainey, Chasz Griego, and Lencia McKee

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Dedication

This book is dedicated to our esteemed colleagues at the Carnegie Mellon University Libraries and to our faculty partners and other collaborators across the Carnegie Mellon campus. Thank you for providing us with support and flexibility to innovate and expand the library's open science services at CMU Libraries.

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Foreword

I was overjoyed when I was asked to write a foreword for ACRL's *The Open Science Cookbook*—not only because it was edited by my colleagues at Carnegie Mellon University Libraries but also because I believe open science should be a fundamental part of every research library.

In 2022, the White House Office of Science and Technology Policy alerted all federal departments and agencies that the results of federally funded research must be made available to the public immediately and at no cost. This policy change must be implemented by the end of 2025; other funding agencies are adopting similar open access policies. Open is quickly becoming the default way to conduct research, and libraries will continue to play a key role by providing broad accessibility, data management options, and specialized guidance.

At Carnegie Mellon, we brought our open science program—one of the first to be housed in an academic library in the United States—to life in 2018. It was inspired by the 2017 AAU-APLU Public Access Working Group Report and Recommendations (https://www.aau.edu/sites/default/files/AAU-Files/Key-Issues/Intellectual-Property/Public-Open-Access/AAU-APLU-Public-Access-Working-Group-Report.pdf) on managing public access data, which called on universities to lead the open access charge. It was clear that if we wanted to accelerate scientific progress and advance innovation, we needed to create new infrastructure and rethink research workflows.

Over the past few years, I have been delighted to share the successes of the open science program at Carnegie Mellon University Libraries with my colleagues at other universities. Likewise, I have enjoyed hearing of their approaches, innovations, and successes in providing open science support. *The Open Science Cookbook* exemplifies this collaborative spirit.

The open science landscape is expanding quickly, and many libraries are looking to each other for inspiration and advice. This cookbook provides a wide variety of recipes for supporting collaborative, transparent, openly accessible, and reproducible research. It serves both aspiring and established chefs alike, whether they are cooking for a crowd or a small group.

In so many ways, open science is the future of academic advancement and innovation across a wide range of disciplines. Just as freely sharing data and workflows enables key breakthroughs in major fields, being open about open science practices and resources can only serve to create an even stronger foundation for this necessary growth at institutions across the country and the world.

—Keith Webster, Helen and Henry Posner, Jr. Dean of the University Libraries, Carnegie Mellon University

Introduction

THE OPEN SCIENCE LANDSCAPE

In January 2023, the White House Office of Science and Technology (OSTP) and the National Science and Technology Council (NSTC) launched the Year of Open Science and released an official definition of open science: "The principle and practice of making research products and processes available to all, while respecting diverse cultures, maintaining security and privacy, and fostering collaborations, reproducibility, and equity." (White House, 2023)

Open science encompasses various practices and philosophies, ranging from open data and open source to open educational resources and open access publishing. While open science introduces new practices and philosophies, such as pre-registration and open data, many of them are not novel and are, in fact, closely linked to traditional research practices. The essence of open science is to promote more transparent, accessible, and reproducible research and to extend beyond the sciences, fostering inclusivity across all disciplines.

Governments, funding agencies, and research institutions will be key in promoting change at the national level as technological, cultural, and policy landscapes evolve and open science becomes increasingly integral to the research process. There are many benefits to practicing open science, including opportunities for interdisciplinary collaboration, increased visibility and impact, and enhanced reproducibility and reusability of research. Research institutions can help lead the way by highlighting the importance of community engagement and developing resources, like this cookbook, that offer ideas for integrating open practices.

THE LIBRARY'S ROLE IN OPEN SCIENCE

Libraries create, maintain, and advocate for an open research ecosystem that is accessible to everyone. Academic libraries provide researchers, scholars, and students access to a wealth of information, facilitate the creation and dissemination of scholarly work, and support researchers in sharing their outputs openly and transparently. For example, libraries often provide researchers with financial support for open access publishing. Institutional repositories, which publicly host research data and outputs, also support open science.

In addition to library infrastructure, librarians support open science through advocacy and education. Librarians offer guidance on best research practices, promote awareness of open science principles, and empower researchers to comply with evolving funding mandates through consultations, workshops, and other training sessions.

ABOUT THIS COOKBOOK

Whether you are new to open science or well versed on this topic, this book, written by academic library professionals and researchers, will provide inspiration, guidance, and practical steps for creating and supporting open science library services.

These recipes are designed to be accessible to library professionals with different skill sets, budgets, and access to resources. Many of the recipes provide ideas for adaptations or approaches to scaffolding based on institutional context. Readers will likely find points of intersection in this book with their own work, as open science overlaps with many bread and butter offerings of academic libraries. Some recipes describe the creation of new services from scratch, while others suggest approaches to expanding services that libraries may already provide, including research data management, open access publishing, and evidence synthesis.

In keeping with the "how to" nature of the book, the recipes are organized into five common library activities: program development, instruction, outreach, events, and collaborations and partnerships.

SECTION 1: PROGRAM DEVELOPMENT

Recipes for creating open science programming in an academic library include building

or assessing an open science program and creating a dedicated open science position in a library.

SECTION 2: INSTRUCTION

Recipes to help chefs add open science flavor to existing workshops or lessons or develop fresh, new open science content include instruction sessions on topics such as copyright and reproducibility.

SECTION 3: OUTREACH

Unique recipes for engaging communities through programming and targeted outreach include promoting practices on campus in a variety of contexts and creating outreach materials.

SECTION 4: EVENTS

Recipes for developing and hosting open science events intersect with themes of community collaboration and outreach.

SECTION 5: COLLABORATIONS AND PARTNERSHIPS

Recipes offer open science approaches to collaborating across your institution and fostering new partnerships, from other research support services to specific user groups.

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Section 1.

Program Development

An Open Science Potluck:

Building a Program that Engages your Campus Community

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NUTRITION INFORMATION

Open science, also known as open research, refers to both the principles and practices of making the tools and results of research transparent, publicly available, and reusable. While academic libraries have traditionally supported some open science ingredients, such as open access and open educational resources, comprehensive support for open science has been less common (Scotti et al., 2025; Wang et al., 2022). However, the recent mandate to make the results of all federally funded research immediately available to the public (Nelson, 2022) has increased awareness of open science, and researchers will increasingly be seeking support as they navigate the open science landscape. Recent policy changes can serve as a conversation starter and generate buy-in with stakeholders, including library administration, library users, and other units on campus.

This recipe will help you create a sustainable and relevant open science program, inspired by insights and lessons learned during the development of the Open Science and Data Collaborations Program at Carnegie Mellon University (CMU) Libraries.

LEARNING OUTCOMES

By following this recipe, library chefs will be able to:

- recognize how new or existing services can be packaged as a program;
- develop a strategic plan for program development, considering available resources; and
- identify assessments that effectively engage stakeholders and evaluate the program's impact.

NUMBER SERVED

An open science program has the potential to impact an entire campus community. However, the impact is largely dependent on the program's funding, the team members' expertise and capacity, as well as the campus's attitudes on "open."

As the program gains its footing, the number served may start small, but existing campus partnerships and relationships can be leveraged to build buy-in. The number served will grow as awareness and interest grow.

COOKING TIME

Chefs should anticipate approximately one year of initial prep time building the open science program, including identifying internal library chefs, existing service courses, and kitchen equipment. Refinement of the program, such as exploring opportunities to address missing ingredients and flavors to better serve campus diners, will take an additional one to two years after program launch. Like most library services, the program can anticipate a need for ongoing refinement.

DIETARY GUIDELINES

Most university libraries already offer a range of services that support open science practices and principles. This recipe helps to package existing services, resources, and expertise into a cohesive program, while also identifying gaps and opportunities. It provides a stakeholder-informed approach for planning, implementing, and evaluating an open science program, so that the program aligns with the tastes and dietary needs of a diverse user community.

Commitment to open science is growing across disciplines and contexts, but significant barriers remain. The aim of an open science program is not to completely shift the

landscape from closed to open but to empower and educate researchers to integrate open science principles into their workflows whenever possible and to recognize the value of open science, both locally and globally.

INGREDIENTS AND EQUIPMENT

An open science program is highly customizable depending on your user community and resources. Mix and match from the following three menus of options for kitchen equipment, ingredients, and dishes.

First, gather your **kitchen equipment**:

- Open science team: comprised of library personnel with diverse perspectives and skill sets in order to support a variety of open science ingredients, such as open access, open data, open source, and open educational resources. Consider which library specialists and staff members have expertise or interest in open science principles or platforms. Perspectives from across disciplines and a range of expertise will help you build a program for a wide, diverse audience.
- Partnerships: collaborative relationships with other units on campus, researchers, or people or organizations external to your institution who can bring their expertise and share cost or other resources.
- Open science program webpage: a dedicated place on your library website to point users to services, resources, and points of contact.
- Open science newsletter: a communication channel that keeps users aware of program developments and updates and helps build a sense of community. The free version of Mailchimp can be used to create and manage a newsletter (see figure 1).
- Program evaluation and assessment tools: used to determine strategic goals and priorities and evaluate program impact. CMU Libraries maintains a program logic model that helps us understand the required resources and impacts of current activities as the program evolves (see figure 2).
- Open source tools: utilize tools such as OpenRefine, Python, R, and protocols.io when possible for cleaning, analyzing, and documenting analysis workflows.

After prepping your kitchen, take stock of the open science **ingredients** you already have on hand, like institutional repositories and open access agreements or funds, before you make a shopping list.

- Open access refers to publicly available scholarly publications, including theses and dissertations. Libraries might provide financial support for open access publishing or guidance on open licensing.
- Open data is publicly available research data that can be reused and modified.

Figure 1. Open science newsletter, February, 2023. Created with Mailchimp.

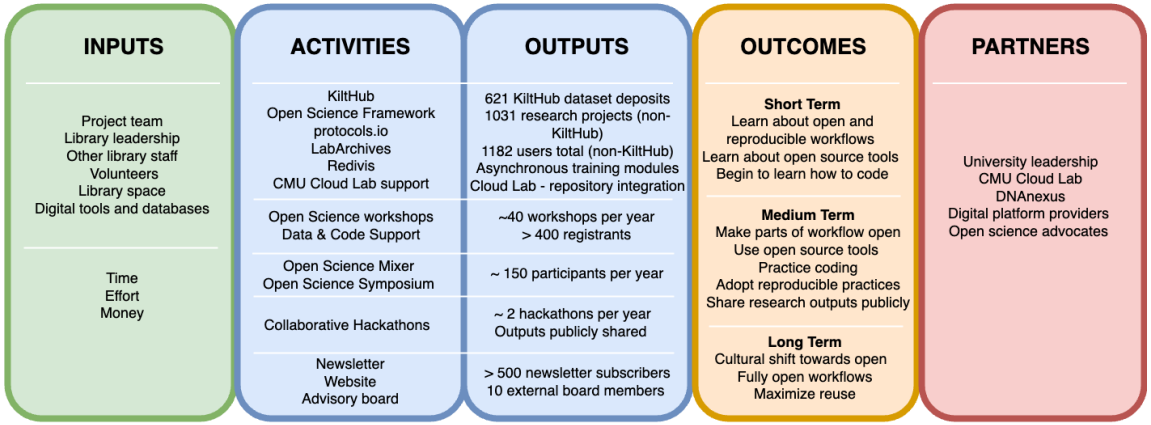

Figure 2. A graphic representation of the program logic model that helps visualize the inputs, activities, and outcomes of the Open Science and Data Collaborations Program (OSDC). The inputs are resources required for all activities. The activities include five types of current activities in the OSDC program, including, from top to bottom: tools, workshop, events, collaboration, and outreach. Outputs are the product of each activity. Outcomes are short-, medium-, and long-term goals. The partners are our current partners.

Good research data management practices are critical for open data. Library support for open data can include guidance on licensing and repositories and on writing data management and sharing plans and READMEs.

- Open source refers to publicly available software source code, coding languages, or tools that can be reused and modified. Library support for open source software will include best practices for licensing and dissemination of software, as well as guidance and training on selecting and using open source research tools in lieu of proprietary options.
- Open educational resources (OER) are free, openly licensed, open-access teaching materials. OER reduce financial access barriers by lowering the costs of textbooks and course supplies, helping to make higher education more equitable and accessible. As openly licensed material, OER allow faculty to tailor learning materials to meet student needs and increase engagement.
- Citizen science, also known as community science, is research conducted by the public or nonexperts, with an emphasis on making the results publicly available. Library expertise on how to openly disseminate research, including interim research products, is valuable for facilitating citizen science.

After choosing your open science ingredients and flavors of open science, it is time to select the **dishes** for your potluck**.** The following list includes some lower-cost and lower-lift ingredients to accommodate smaller budgets and teams.

- Training opportunities*:* Libraries can offer consultations and workshops on any aspect of open science, including practices, principles, and tools. Since these are bread-and-butter library services, this is an excellent option for a smaller budget or team. Workshops that offer practical guidance on specific tools, resources, or research processes tend to entice diners.
- Tools and resources: Support open research by providing tools that facilitate collaboration, sharing, and reproducibility. Libraries can offer institutional licenses and provide guidance via consultations, workshops, or outreach materials such as LibGuides. Library chefs with limited budgets can support tools or coding languages that are free or have a free version, such as OpenRefine, protocols.io, Open Science Framework, Python, or R. If many types of support exist for a given skill, consider packaging them into a scaffolded suite of services and resources. For example, CMU Libraries provides a data and code support service, which offers scaffolded support for coding in open source languages, including foundational workshops, books, and asynchronous resources. Users can also book appointments for individual consultations.
- Events and advocacy: From casual mixers to symposiums (see figure 3), events not only raise broader awareness of open sci-

Figure 3. Marketing poster for the second Open Science Symposium hosted by the Open Science and Data Collaborations Program.

ence on campus and beyond but also offer an opportunity for researchers and other stakeholders to engage in conversation on the opportunities and challenges of open science. CMU Libraries hosted Morning Brew: Exploring Open Science at CMU Libraries, a low-cost, informal mixer with coffee and pastries, to share our services and connect with open science connoisseurs in our campus community (see figure 4). You can also use social media or even physical whiteboards to engage the campus community in ongoing conversations about open science.

- Collaborative research: Organizing and facilitating a collaborative research opportunity can be a great way to teach open science with a learn-by-doing approach. Examples include hackathon-style events and evidence synthesis projects (see chapters 8 and 21).

COOKING METHOD

Here are step-by-step instructions for cooking up a delicious open science potluck (see figure 5):

Step 1: Identify goals and assemble an advisory board.

- Start by identifying the questions you hope to answer with program assessments and choose assessments accordingly (Wang et al., 2022).
- Note that user data can help you understand the roles and affiliations of users and how adoption or use of services has changed over time. Qualitative data, including feedback from focus groups, an advisory board, or surveys, can offer further insights into how services are being used, the barriers to their use, and their impact.
- Invite campus community members with a variety of disciplinary backgrounds and roles to participate on the advisory board so that it offers a rich medley of perspectives. Outline expectations for time commitments and member contributions.
- Once the board is assembled, create a place on your website to list board membership.

Step 2: Use focus groups to develop and refine program offerings.

- Identify key stakeholders to ensure representation and engagement.
- Craft questions for focus groups that will help gather insights into culinary preferences, dietary requirements, and cultural influences.

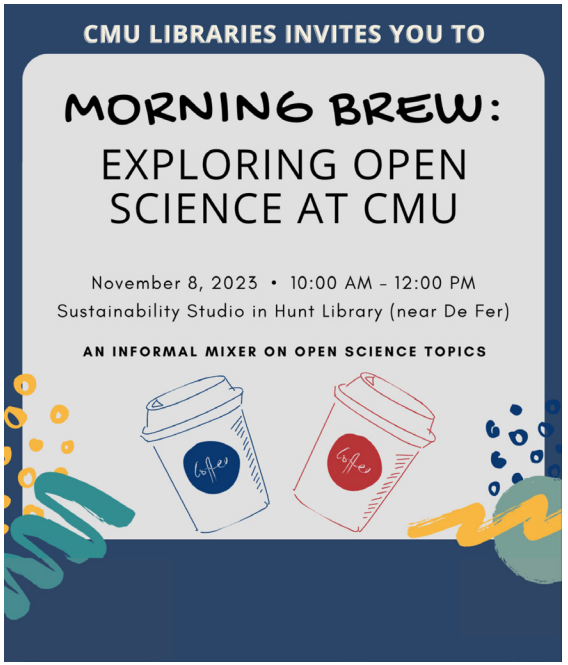

Figure 4. Marketing poster for an open science mixer hosted by the Open Science and Data Collaborations Program in 2023.

- Design the structure of focus groups, including group size, participants, location, and session length.
- Utilize existing channels, such as library liaisons, newsletters, or faculty or student networks, to distribute a compelling recruitment call.
- Assign roles such as moderator, notetakers, and Zoom manager, and ensure logistical arrangements are in place for seamless execution.
- Hold focus groups throughout various program stages to gather feedback and identify evolving needs, preferences, and challenges.
- Transcribe recordings of focus group discussions and code recurring themes for analysis.

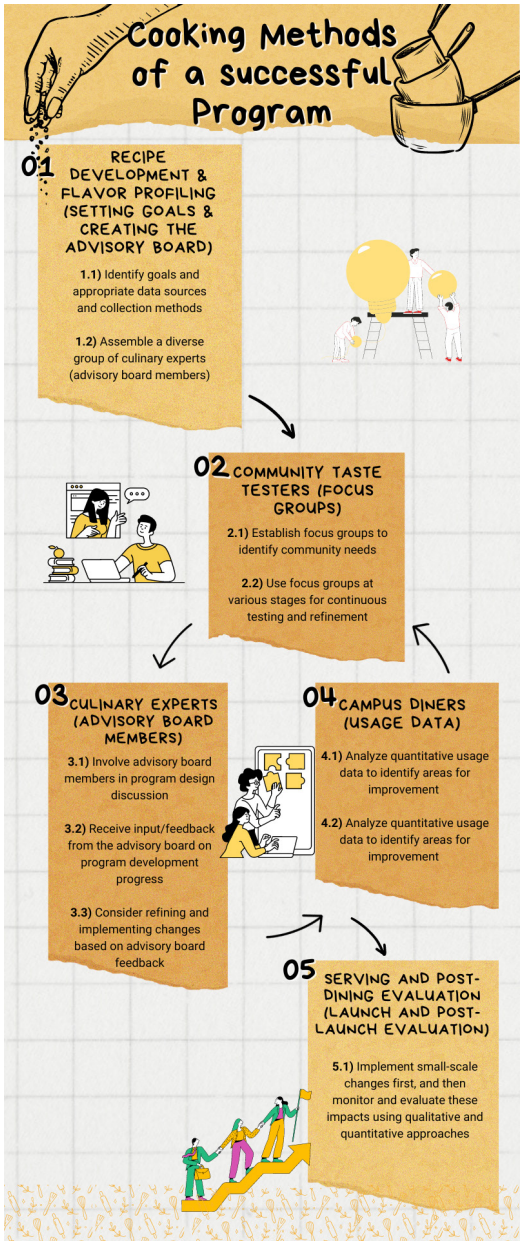

Figure 5. Graphic representation of the Cooking Method section. Created with Canva.

Step 3: Engage advisory board to help with program design.

- Schedule regular gatherings with the advisory board to engage in discussions about program design.
- Encourage active participation and open dialogue during meetings to infuse expertise and insight into program design.
- Use advisory board input and feedback to supplement, guide, and hone the team's ideas for program development and refinement.
- Present early prototypes during meetings for the advisory board to test and assess feasibility, relevance, and potential impact.
- Pilot test services and resources, gathering feedback on usability, functionality, and content from the advisory board.
- Regularly review program data and metrics with the advisory board to continuously enhance the program's impact and effectiveness.

Step 4: Analyze quantitative usage data to identify areas for improvement.

- Ensure data collection goals and methods are already established and integrated into the program's workflow.
- Allocate time for data analysis to explore and evaluate the usage data gathered from the program.

- Depending on the team's skill sets and experiences, consider using open-source tools and programming languages to facilitate data analysis.
- Focus on key metrics such as user engagement and retention rates to identify areas for improvement.
- Examine data to identify patterns, trends, and areas where usage may be lower than expected or where users encounter difficulties.
- Keep an eye out for "superusers," who use multiple program services and might be interested in serving on the advisory board.

Step 5: Continue evaluating program

- Start with small-scale changes to monitor effectiveness and gather additional feedback before launching larger initiatives.
- Continue to evaluate program initiatives with both quantitative data and qualitative feedback and make changes accordingly.

CHEF'S NOTES

Remember that many of the components of an open science program might already be offered in your library. It is helpful to map existing services before seeking additional resources. For example, before our open science program was established in 2018, CMU Libraries already offered KiltHub, CMU's institutional repository, and an APC fund to support open access publishing.

While it is important to maximize existing or free resources when starting a program, funding for dedicated Open Science employees or dedicated FTE can help build more robust programs as they mature. For example, having multiple specialists to support data management, open access publishing, copyright, and additional staff to support programming and outreach can significantly enhance program effectiveness. Funding can also be used to acquire licenses for tools to support open and reproducible research.

Keep users, stakeholders, and campus leadership informed and engaged by regularly sharing milestones and upcoming plans through communication channels like newsletters, social media, and websites. Share personal stories that highlight diverse voices and experiences to showcase the impact of the program on real people. Provide opportunities for open feedback through surveys, forums, and dedicated channels. Respond to as many user comments as possible. Please note: when communicating to a diverse audience, try to avoid technical jargon, and make content digestible and engaging.

Work as a team to consolidate and analyze feedback and data. Create narratives, visuals, case studies, or testimonials to highlight key themes, trends, and common concerns. Transparency and honesty are key: highlight successes; acknowledge challenges; and communicate plans for improvement.

ADDITIONAL RESOURCES

Logic Models

Newcomer, K.E., Hatry, H.P., & Wholey, J.S. (2015). *Handbook of practical program evaluation*. John Wiley & Sons, Incorporated.

SMART goals

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Establishing an Effective Open Science Team:

A Recipe for Cultural Change in Institutions

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NUTRITION INFORMATION

This recipe strives to be a valuable resource for anyone interested in championing open science at an academic institution. The steps outlined here will guide you in building an effective open science team that will work towards a more open and collaborative future in research. The aim of an open science team is to increase awareness of open science and to gain insight into the requirements of all individuals involved in research so that they can engage with open science practices more effectively. Often, researchers are aware of some open science concepts, but they may not know how to begin implementing open science practices in their work. An open science team can start setting up implementation guidelines, as well as serve as a platform that unites open science enthusiasts who are willing to contribute to the advancement of open science principles. Direct lines with leadership also allows for change and impact at the institutional level.

While the overarching goal is to establish a long-term presence for the open science team, it is designed with the flexibility to accommodate the diverse commitments of its individual members. An open science team is an asset to the institution, but it also offers team members an opportunity to learn more about open science and cultivate transferable skills that may be relevant to future tasks and opportunities.

LEARNING OUTCOMES

When following this recipe, you will learn more about:

- **How to build an effective open science team.** This includes strategies for recruitment, organization, and fostering participation and collaboration among team members.
- **Creating impact at the institutional level.** How can you use a team to advocate for and implement changes supporting open science principles at the institutional level?

NUMBER SERVED

The open science team provides individual team members with opportunities and influences each team member's department. This influence extends not only to the department or institute where the open science team is based, but also to the entire university. For example, our open science team serves as a model for other institutes within the university, which have been inspired to set up their own open science teams.

COOKING TIME

Setting up a team may take several months, as gathering all the ingredients is no small feat. The first crucial step in setting up an open science team is to seek the necessary approval and alignment with leadership. This may involve gaining approval from your institute or department's leadership, academic committees, or other relevant parties. Be prepared to outline your goals, objectives, and the potential benefits of having an open science team at your institute. Gaining support for the team may take several months.

Our open science team held four ninety-minute-long team meetings during the academic year. This alignment with the academic

year ensures that your initiatives fit into the schedules of team members. Team meetings will take preparation: team members typically required thirty minutes, while the coordinator typically spent ninety minutes preparing for each meeting.

DIETARY GUIDELINES

The aim of an open science team is to increase awareness of open science and to gain insight of the requirements of researchers so that they can engage with open science practices more effectively. Researchers are increasingly asked by journals, funders, and institutes to follow open science practices, which can be difficult if they are not sure where to begin. An open science team can help evaluate the practices that are already well established within a given institution/department and determine what additional support (in the form of courses, workshops, guidelines, or information sessions) may be helpful.

INGREDIENTS & EQUIPMENT

This recipe requires the following ingredients:

- a **team** of at least four and no more than ten members**:**
  - Team members should be representative of your organization's composition in terms of department and population.
  - Each team member should be able to attend team meetings and dedicate time to their assigned responsibilities.
  - The open science team at our institute consisted of eight members, with at least one representative from each of the six departments (one department was represented by two PhD candidates). Team members were chosen to represent a diverse spectrum of backgrounds (seniority, research or work focus, gender, position) to ensure diversity in the perspectives that were brought to the table.
  - Members should ideally serve for a minimum of one year, with the option to continue into the next year. Slow, yet regular turnover of team members will help to ensure that new topics and issues faced by researchers can be recognized and addressed quickly.
- A **coordinator** with sufficient time to organize team efforts (ideally around one hour per week of dedicated time).
- **Support from leaders** in the organization, which can take the form of language in the strategy or mission statement that underscores a commitment to open sciences practices and/or direct lines of communication with the management team.
- **Communication channels** such as email or a Microsoft Teams Channel, or survey tools such as Microsoft Forms.
- **Rooms** for team meetings, as well as access to food and snacks.
- **Presentations** and/or **tools** such as Mentimeter and Slido to gather input from discussions or surveys.

PREPARATION

It may take time to get leadership on board to be able to start with your open science team. Engage leadership with the latest developments regarding open science, particularly recent requirements from research funders. For example, the main funding program for research innovation of the European Union, Horizon Europe, includes open science practices in the scientific excellence criteria of their proposals (European Commission, nd) meaning that progression in open science is part of the evaluation of the proposal. Horizon Europe also requires Data Management Plans for their projects, which prepare researchers to share all the different types of outputs of their research projects. This increased focus on open science practices by funders is likely to grow in the coming years, and should draw the attention and support of management for any activities that mean to increase the awareness of them in your institute.

To stimulate participation in the team, it can be helpful to consult with potential team members to see what they hope to gain through their participation. This includes, offering 'credits' of some kind for PhD candidates which they can use in their educational modules of their PhD projects, ensuring that they receive compensation for their involvement. Another example would be the opportunity to contribute to visible outputs, such as a final report (TNW, 2023), a GitHub repository (Meindlhumer & Plomp, 2023), or a recipe like this. This compensation may look

different for team members, depending on their backgrounds, ambitions and needs.

Consider developing a survey to be used before the first team meeting. This survey will help in assessing individual team members' perspectives, strengths, and requirements. For example, if team members need more information on a certain aspect of open science you can already prepare and accommodate for this before the first meeting. This initial input via the survey will be invaluable in shaping the scope of the team's mission, as well as the milestones to be achieved. Be prepared to adapt mission and goals based on ongoing feedback from team members. Thanks to the survey that our team conducted it was possible to quickly align the various degrees of team member's expertise regarding open science (most team members had not heard of topics such as 'preregistration' or 'open hardware'), and then move to the areas that were of most interest to team members— such as open access, open data, open software. We used team members' responses to a survey question—What would a successful open science team accomplish?—to articulate the team's mission: The open science team works together to inventorize the requirements of researchers so that they can engage more successfully with open science practices.

It will be helpful to familiarize yourself with cultural change theory, as your team's ultimate goal is to change your institution's culture around open science practices (figure 1). Consider enrolling in a course on cultural change, or explore resources like Kotter's 8 Steps for Leading Change (Kotter, 2012) or The Turing Way's section on cultural change (Turing Way Community, 2022). This knowledge will equip you with the insights and tools necessary to more effectively support the open science team.

COOKING METHOD

1. Seek out support from leadership.
2. Assemble team members. Approach individuals who share your passion for open science and are willing to contribute their time and expertise to the cause. Consider diversity in expertise and perspectives to ensure a well-rounded team. This recruit-

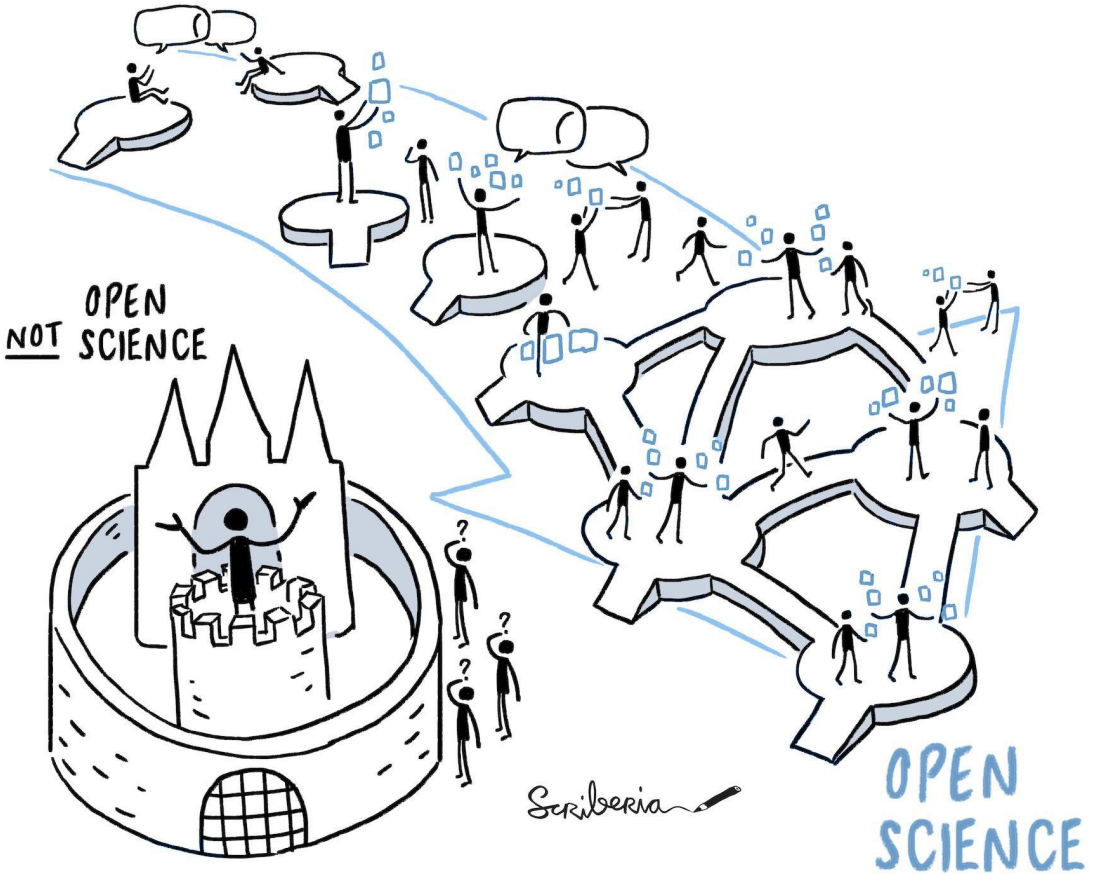

Figure 1. Graphic illustration of Open Science principles. Image adapted from an illustration created by Scriberia with The Turing Way community, used under a CC-BY 4.0 licence. DOI: 10.5281/zenodo.3332807.

ment process may take some time as you identify and engage potential team members.
3. Schedule the first meeting; make sure all team members are able to attend so that everyone is introduced to one another.
4. Create and send a survey to get to know the needs and ambitions of team members and to prepare an agenda for the first Team meeting. You may have to remind team members to fill out the survey.
5. During the first team meeting, refine the goals/scope of the team and establish objectives. Estimate how many more meetings will be needed for the team to achieve those goals and milestones. (Our open science team held four meetings per academic year.)
6. Reach out to stakeholders outside of the team. Our team connected with other groups at the university interested in open science practices (such as the Data Champions and Open Science Community).
7. Set up an evaluation meeting to consider what milestones and goals are reached. If there are remaining objectives to be achieved, they may be accomplished in a future round of the team.
8. Report back to leadership on the team's progress to keep open science on the agenda and solidify support for the team and its activities.
9. Restart a new round of the open science team for the new academic year.

CHEF'S NOTES

We recommend planning meetings one to two months in advance to accommodate for team members' busy schedules (particularly those of more senior researchers). When it is not possible to find a time and date that works for everyone, you can take notes during meetings, to be shared with the entire team, and follow up with any absent team members to get their feedback and input.

In addition to planning ahead, communication is key. It is crucial to have well-defined goals and to communicate them clearly, along with any associated activities and deadlines. Team members will be more motivated to engage if it is clear how they can contribute (by providing them with a draft idea, agenda or text in advance), and in what time frame they should provide input. Ensure that team members have at least a week to provide feedback. Don't hesitate to send reminders or solicit follow-up feedback if initial responses are limited.

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Growing Open Science Services from the Ground Up

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NUTRITION INFORMATION

This is a recipe for developing an open science program at a research university, using Florida State University (FSU) as an example. Readers will learn an iterative and collaborative process, moving from an experimental to a strategic approach, for creating an open science program, including an open science faculty position, which will allow them to provide open science support and services to their campus community.

The open science program at FSU began as a pilot program focused on supporting federal public access mandates. The program evolved to meet diverse needs in data management, open data, and open access. These efforts culminated in the creation of an open science librarian position and the formation of a cross-divisional task force that coordinates a robust suite of services to advance open science. This chapter will highlight the importance of reprioritizing existing positions to focus on open science, the process and benefits of building relationships with research support partners outside the libraries, the impact of crafting practical proposals for library leadership buy-in, and the necessity of ensuring regular internal communication across the library to ensure all organization members are adequately informed and positioned to support nascent efforts.

LEARNING OUTCOMES

Readers will be able to:

- identify challenges associated with developing an open science program;
- create a plan for developing an open science program at their library;
- advocate effectively for support from their leadership team; and
- identify background factors and possible collaboration opportunities with other campus research partners.

NUMBER SERVED

This recipe can be scaled to serve any number of people, from small open science communities to the vast networks of researchers supported by many university libraries.

COOKING TIME

Collecting background information and campus needs assessment will take some time. Strategy building will take a few weeks; running a pilot and collecting stakeholder feedback and leadership advocacy will take two to three months. Recruiting faculty may take several months.

DIETARY GUIDELINES

The 2013 Holdren memorandum (Holdren, 2013) mandated that federal agencies with large research budgets develop plans for making publications and data publicly available. In response, many universities began to promote open science practices to ensure that researchers at their institutions would be in compliance with these new policies. University libraries have begun to build open science programs and design new positions to support the university community in advancing open science practices. Because these new programs and services intersect with a broad range of library functions—from outreach to instruction to collections to technical infrastructure—librarians with experience and expertise in open science practices are coordinating highly collaborative projects that transcend traditional library divisions.

At FSU, librarians started by offering consultations and workshops on open science practices and tools for research, instruction, and data stewardship. A vacant science librarian position was modified to focus on leading these open science efforts. This resulted in the creation of the open science Task Force (OSTF) to advance the library's ability to teach and advocate for open science principles and practices.

The OSTF is an interdisciplinary team that plays an advisory role and functions as a working group for the library's open science initiatives; their priorities and objectives include:

- identifying open science needs on campus using survey instruments and focus groups
- initiating projects and programs to promote open science
- building services to support researchers in adopting open science practices
- monitoring new developments in open science policy, advising researchers and other stakeholders on their impact, and adapting library support services accordingly

INGREDIENTS AND EQUIPMENT

Creating new services and programs that support open science requires engaging with stakeholders across the library and campus communities, who will offer different perspectives and strategies on advancing public knowledge.

The following are also helpful to have:

- an understanding of open science practices
- a commitment to collaborating with other teams and establishing clear communication among team members and with leadership
- good proposal writing and project management skills;
- a willingness to increase organizational knowledge in regard to open science principles and practices.

PREPARATION

Open science is an encompassing and broad concept that is centered around making research information publicly available, typically through open access journals or open research datasets (Park & Wolfram, 2019). Open science work at the FSU Libraries began with eScience and scholarly communication efforts in the early 2010s. More recent efforts in advancing open science practices on campus stemmed from a collaboration between the library's Office of Digital Research and Scholarship (DRS) and the STEM team (STEM).

In 2014, DRS and STEM partnered to create and deliver consultative services around public access mandates, specifically those from the NSF and NIH. This involved coordinating outreach efforts with stakeholders inside and outside of the library, as well as learning to provide consultative services related to data management planning and writing data management plans. In 2015, the DRS and STEM teams collaborated to promote and provide learning support for the Open Science Framework (https://osf.io/). The DRS team was responsible for the procurement and technical aspects of the project; the STEM team worked on outreach and provided training on the new tool.

The DRS team developed a robust suite of services to support open publishing on campus, enhancing existing services, like the digital research repository and open access publishing fund, as well as launching new initiatives, including the library publishing program and academic web hosting service. These programs and services complement those developed by the STEM team and together meet open science needs at different stages of the research lifecycle.

Building and maintaining mutually effective partnerships has been essential to the library's work on open science. FSU's Office of Research Development and Office of Research Compliance have been partners in the delivery of research data management programs and services. The Office of Research Development encouraged the library to explore data management planning as a service and have been champions in advertising and promoting the library's services in these areas for almost ten years. In 2016, the Office of Research asked the library to draft the campus research data management policy as well as policies related to public access to research publications, authorship, and research integrity. (Please see Ippoliti et al., 2018,for more details related to this partnership and related outcomes.)

Key library initiatives to advance open science at FSU include: teaching with open source and free tools, enabling effective data stewardship through data management advocacy and education, providing infrastructure and expertise related to open publishing, piloting new library services to support open science practices, and creating a dedicated open science librarian position. In addition, one librarian's title was changed to research data management librarian to reflect their

increased focus on this work. (For more details, see Julian & Ruhs, 2022; see chapter 3 for more information on creating an open science librarian role).

COOKING METHOD

Based on our experience at FSU, we have several recommendations for librarians who are seeking to grow open science services at their institutions.

1. **Enlist the support of open science champions on campus.** Open science champions are individuals who have influence in the academic community and can advocate for open science practices. By partnering with these advocates, libraries can benefit from their reputations and professional networks, which helps to increase awareness and acceptance of open science initiatives. Collaborating with champions also fosters a sense of community and ensures that the library's efforts align with the broader institutional goals of promoting transparent and collaborative research practices.
2. **Advocate for the reprioritization of existing positions to focus specifically on open science.** Obtaining funding for new positions is a redoubtable challenge for most academic libraries. By reprioritizing existing positions, libraries can not only avoid this challenge but also harness the expertise of current library staff who are interested in advancing open science initiatives. This approach optimizes resource utilization, reduces the need for additional hiring, and underscores the library's commitment to open science as an integral part of its mission.
3. **Form cross-divisional teams that include representatives from across your organization.** These teams can bring together complementary skill sets, knowledge, and perspectives to create a holistic approach to open science support. Collaborative efforts enable the library to tap into a wide range of expertise, from data management to scholarly communication, ensuring that open science services are well-rounded and can address the diverse needs of researchers. This approach promotes strategic collaboration, minimizes silos, and fosters innovation by bringing diverse perspectives and skill sets to the table.
4. **Forge relationships with research support partners outside the libraries.** Collaborating with research offices can significantly enhance the library's capacity to provide comprehensive support for open science. These partnerships can expand the reach and impact of open science initiatives by identifying shared resources, complementary expertise, and collaborative opportunities. They can also help to raise the profile and credibility of the library's efforts in this area and help to position the library as an essential contributor to the research enterprise on campus.
5. **Develop effective proposals to library and university leadership to secure needed funding.** Adequate financial support is crucial. Librarians working in this area should look for opportunities to develop and present well-structured, evidence-based proposals that emphasize the long-term benefits of open science for the institution, the academic community, and the broader research landscape. Based on our experience, most of these proposals will not be successful—be persistent! If you ask regularly, you may eventually succeed in securing additional resources to build out open science services and infrastructure. And if you don't ask, your chances of securing funding fade to zero.
6. **Ensure regular internal communication across the library.** Regular and transparent internal communication is a strategic necessity to ensure that all members of the library are informed and prepared to support nascent open science efforts. This practice helps to cultivate a shared understanding of open science goals, strategies, and achievements among library staff. Informed staff are better equipped to embrace and contribute to open science initiatives. This approach also encourages staff engagement, participation, and a sense of shared ownership in the library's open science initiatives.

CHEF'S NOTES

Create capacity and space for work to avoid burnout and unrealistic expectations. At FSU, open science responsibilities were assigned to a new librarian who did not have existing projects and assignments.

During the first few months to a year of

developing your library's new open science programs and services, dedicate time for research: read articles, listen to webinars, and engage with open science learning communities and communities of practice.

Start where you can, and work with what you have. Use existing library tools or free resources, like the free version of the Open Science Framework (https://osf.io/). Initial efforts will pave the way for future growth and improvement.

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Creating an Open Science Librarian Role

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NUTRITION INFORMATION

This is a recipe for creating a librarian position focused on the creation and delivery of library programs and services that advance and support open science practices and principles. The first part focuses on getting the right ingredients and making sure your kitchen is ready for this potentially complicated dish by creating and finding additional resources and capacity as well as ensuring organizational alignment. The second part details the steps of learning to cook, creating a menu, and sending out those first few plates of open science by highlighting things someone responsible for advancing open science at their library should focus on to ensure collaboration and engagement.

LEARNING OUTCOMES

After reading this recipe, chefs should understand the tasks and priorities of a first-year librarian dedicated to a new initiative. This recipe will also equip chefs with an array of strategies to advocate for a new open science librarian position, promote organizational change, and advance open science principles and practices.

NUMBER SERVED

Open science principles are fundamental to the way research happens in our colleges and universities, across all academic disciplines. Open science makes the results of academic research freely and publicly available, extending the benefits of open science extend beyond the walls of the university. A new open science librarian has the potential to impact the entire research community, both on and off your campus, highlighting the role of the library as a champion of information access and sharing.

COOKING TIME

The time for preparation will vary based on the needs and resources of your institution. In our case, it took about two years of preparation, which included the opening of a STEM librarian position, strategizing on the future of that position, advertising and hiring for an open science librarian, and time for the new librarian to "simmer" and acclimate to their new environment. It is important to allocate time for team discussions, as well as time to incorporate feedback along the way. This could take a couple of months or even a year, depending on the institution, but it starts with that first key ingredient—capacity. Libraries cannot create space and capacity to do new things without deprioritizing other work, hiring new staff, or having the opportunity to repurpose vacant positions. Make sure to plan for around six months of "simmer" time for your new open science librarian to get acclimated.

DIETARY GUIDELINES

This recipe is not recommended for chefs who already may have too much on their plate or are not in a position to free up some extra burners on the stove by deprioritizing other work.

We do recommend that this recipe be paired with complementary dishes; it may not be as delicious without an ensemble of aligned entrees, so make sure to get a taste of everything that's already on the menu before you start cooking. Open science naturally pairs with things like scholarly communication, academic publishing, and open access. It also has the power to spice up liaison or subject librarian services, especially those in STEM disciplines.

New library programs and services to advance open science should also be in alignment with the overall mission and strategy of your library. This may involve some extra steps like talking with administrators inside and outside of the library to learn more about where open science fits in the library's menu of priorities.

INGREDIENTS AND EQUIPMENT

Many open science tools are free and open source; others offer a free version. Some tools to consider exploring for implementation are:

- Open Science Framework for research sharing and collaborative project management
- ORCID as a persistent digital identifier (PID)
- DMP Tool to assist with writing data management plans (DMPs) based on grant requirements
- Re3Data to identify suitable data repositories

Trust and transparency are important ingredients in any organizational menu. New programs and services must be communicated up, down, and across the organization. It is also important that all of the chefs in the kitchen support the creation of this new and complex dish. Administrative support inside and outside of the library will go a long way in making sure this recipe turns out with the robust flavors that are required to sustain complex initiatives like open science.

Determining which aspects of open science—publishing or researching data management, for example—the new open science librarian will be focused on, at least initially, will help hone your ingredient list. You may even be able to use ingredients that are already in your cupboard.

PREPARATION

Start with a lot of capacity and support. If you do not have this, your recipe will not turn out as planned, so take time to ensure that your library is adequately resourced to take on this work.

Create an open science role in a new, vacant, or existing position. While new positions always taste great, they are a relatively rare ingredient that can be substituted by reimagining a vacant position or reprioritizing someone else's role. Just remember that without capacity, the person in this role will have a hard time succeeding.

Assign or hire the right person for the role. Hiring the right person is easier when you know what open science work will be prioritized. For example, you might want to hire or assign someone with experience in academic publishing or scholarly communication.

For other roles, a specific science librarian who already has some subject expertise could make an immediate impact. In other cases, hiring someone with outstanding communication skills, event planning expertise, or outreach experience could be just what the kitchen needs.

Advancing open science work takes time, capacity, and lots of engagement across the campus community. Some ingredients, like rare spices, will take time and effort to procure. Like a pot of chili, be prepared to let your dish simmer and rest for the best flavor.

COOKING METHOD

Once you have hired an open science librarian, we recommend the following steps to ensure a successful first year and a solid foundation to build on:

Learn as much as you can about open science. Read the landmark studies around the replication crisis in psychology (Open Science Collaboration, 2015) and similar open movements in other fields. Search the literature for the most current research and case studies to make sure you are up to date, especially since the COVID-19 pandemic, which necessitated many advancements in open science procedures and practices. Consider different theories and schools of thought about what "open science" means and about the best practices for effective open research. Every institution and even every department within an institution is different, so what it means to effectively support open science practices will vary depending on your unique institutional context.

Investigate the current open science landscape at other institutions. Study established open science programs. See what tools, like the Open Science Framework or protocols.io, they offer and how they support them. Also consider international open science efforts (e.g., European Open Science Cloud, Africa Open Science Platform, cOAlition S) and organizations working in the field of open science (e.g., Center for Open Science, Higher Education Leadership Initiative for Open Scholarship, NASA Transform to Open Science) to find models and resources for your open science program.

Connect with campus partners. Connect with librarians at your institution who have already been working in related spaces, like

academic publishing and open access, data management and visualization, open educational resources, and reproducibility to learn what the library is already doing in these spaces and find collaborators. Seek knowledge and support from any existing open science adjacent committees or groups. Campus research centers can also be valuable partners both for assessing researchers' needs and promoting open science to researchers.

Assess the current state of open science practices on campus. Determine which open science practices researchers are currently employing and what institutional resources and infrastructure exist to support them. This can be tricky because researchers may not be familiar with what the term "open science" encompasses, so they may not be aware that they are already participating. Ask about specific practices, like sharing data and methods, like pre-registering studies, to ensure that you get a complete picture of what is happening on campus. Ask about any barriers or gaps in resources and services that prevent researchers from incorporating open science practices into their workflows. This can be accomplished through a survey, like the Open Scholarship Survey developed by COS (https://osf.io/nsbr3/), focus groups, informal conversations with faculty or researchers, meetings with research centers, or another approach. Talking to other librarians who have conducted similar information-gathering missions at your institutions can help you decide on the best course of action.

Look to the future for program development. Use what you have learned, the connections you've made, and resources you've identified to begin to build an open science program. Form a task force of interested parties, internal or external to the library. Analyze the data you've gathered to identify stakeholders' needs and what resources and services you can create to meet them.

Find ways to connect open science to your other projects and roles. Librarians working in the open science space will likely have other roles that they must also juggle. In many cases, this includes liaison or subject librarian assignments, which can provide opportunities to learn more about the open science needs of faculty in your assigned liaison areas, as well as a captive audience for gathering feedback on open science initiatives and projects. In our case, the open science librarian also has liaison librarian responsibilities for engineering and biological sciences.

CHEF'S NOTES

As a new open science librarian, resist the urge to jump directly into creating new workshops or programs. While it may be tempting to work on something that yields short-term results, this recipe takes time to simmer to create opportunities for long-term success. Begin by building a foundation of knowledge about open science practices, tools, and resources, and thoroughly understand the current status of open science practices at your institution. Take your time and have fun!

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The Library is Not Enough:

Building the Data Governance Community at Your Institution

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NUTRITION INFORMATION

While many open science programs and services are initiated by or hosted within academic libraries, managing data and open science practices at the institutional level requires the broad engagement of many offices and departments. Greater demand for data sharing means increased expectations for documentation, infrastructure, and staff expertise to enable data discovery and reuse, which demands a larger support system than what presently exists at most institutions. Current practices at many institutions center on a single view, such as that of information security compliance, or have inconsistencies between institutional needs, goals, and obligations. A broader community—a community kitchen—is needed in order to address the gaps between existing services and emerging institutional needs and aspirations in order to better support the research mission of our institutions.

A community kitchen is a place for shared planning, creating healthy and affordable meals, and preserving food for the future. Shared governance of research data recognizes the needs of all stakeholders and creates space for developing shared values. Creating a community kitchen can occur under the umbrella of "data governance," which is "a system of decision rights and accountabilities for information-related processes, executed according to agreed-upon models which describe who can take what actions with what information, and when, under what circumstances, using what methods" (Data Governance Institute, 2023). Governance is not just a set of compliance requirements; it is a collective activity that should reflect the priorities and needs of the community. While governance serves the institution, it is also about building a community of support for those who support research data.

Data governance at colleges and universities has historically been established for administrative and institutional data, such as financial or student data, but the evolving policy landscape and interest in open science have created new needs related to research data governance, such as open data sharing. A logical next step for librarians is to participate in or to coordinate research data governance activities at their institutions.

LEARNING OUTCOMES

Through reading this recipe, readers will be able to:

- understand the implementation process for collaborating across their institutions to uncover and solve data problems;
- identify offices and personnel that have a role in research data governance discussions; and
- develop a vision for data governance at their institutions which responds to the shifting landscape around research data.

NUMBER SERVED

This is a recipe that should be baked on the scale of the institution. This is a case where you want all of the cooks in the kitchen, or at least a significant number of cooks. Once gathered, the cooks determine who needs to be served first and what dishes to bake.

COOKING TIME

This is a slow bake that will require repeated trips to the oven over the years. Some changes or governance activities, such as forming an initial data governance group, may be completed with relative speed. However, other activities, such as, identifying and

implementing software solutions to support governance activities or working on policy that requires approval from a series of institutional reviewers, may require significantly more time.

DIETARY GUIDELINES

Setting up data governance structures requires expertise in data management, IT, and research compliance. The first step in developing data governance is to get the relevant cooks into the kitchen to share expertise (see the Cooking Method section below). The cooks then determine the dietary data guidelines for the entire institution. For example, how does the institution handle sensitive data? What happens to a researcher's data when they leave the institution? How does the institution comply with emerging government data requirements? It is better to anticipate answers to these questions than to deal with problems that arise in the absence of such data guidelines. A portion of data governance will always concern research compliance, with the goal of staying on the right side of compliance rather than dealing with data nightmares. With the right people in conversation (see the Ingredients and Equipment section below), customized guidelines for the institution can be developed.

Processes for sharing research data versus administrative data differ significantly. Additionally, the cultures and norms associated with research data are much more varied and shift rapidly in relation to external demands (e.g., frequent requests for one-off data use/sharing agreements due to a lack of appropriate controlled-access repository networks, demand for third-party tools that replicate existing services, or creation of customized data "repositories" for sharing data associated with a particular project). Gaps are highlighted when researchers develop ad hoc workflows or workarounds for managing and sharing data because they are unaware of or feel unable to rely upon established institutional processes.

Research data governance practices might include: creating and maintaining data policies, developing infrastructure for data retention, establishing and refining data workflows, and ensuring that the institution meets legal, government, funder, and publisher obligations for open sharing. These practices seek to address the gaps between administrative needs, compliance requirements, and the goals of research teams. Research data governance provides infrastructure and processes for open science practices such as sharing data sets for reuse, creating open educational resources, supporting research reproducibility, and expanding collaborations.

While many understand that open science is not in opposition to research compliance or security, procedures related to information security and data sharing/use agreements are typically developed without considering the broader impact on researchers who desire or are obligated to share beyond the minimal requirements. For example, ensuring that collaboration systems are selected and configured to meet security requirements while facilitating research with external partners. Similarly, planning to share data for reuse must include ensuring appropriate participant consent, selecting a suitable repository, and creating sufficient documentation for reuse.

Academic librarians are already serving as open science leaders by hosting institutional/data repositories, engaging in outreach and instruction with students and faculty, and fostering communities of practice across disciplines. Research data governance is a natural extension of that leadership.

INGREDIENTS AND EQUIPMENT

Research data governance requires the synthesis or inclusion of diverse perspectives and expertise from across the institution, including:

- executive sponsors of the data governance program
- data stewards and data governance program administrators
- librarians
- institutional research administration officers
- research compliance and integrity officers (e.g., HIPAA or privacy/security officer)
- research contracting specialists and/or legal counsel
- research development professionals (e.g., NORDP)
- information technology officers, including those supporting enterprise applica-

tions as well as research-specific applications (e.g., chief privacy officer)
- information policy and security officers (e.g., chief information security officer)
- innovation and commercialization/technology transfer officers
- faculty researchers
- college, school, or departmental level administrators (e.g., school-level associate deans for research)
- research cores or centers or shared services personnel
- records managers

Equipment may include:
- time and space to bring people together to discuss and learn from each other
- a shared charge or memorandum of understanding (MOU) to provide authority for the governance group to act
- support from unit leaders to spend time collaborating across unit boundaries
- infrastructure to support data classification, inventory, policy and guidance, etc.
- processes for authorizing and distributing resources created by a team that spans multiple units

PREPARATION

The first step in developing data governance is to bring the right cooks into the kitchen. Identify organizational structure to ensure appropriate representation of key stakeholder groups on both academic and operational sides of the institution. Additional stakeholders may be brought in to discuss specific governance concerns.

Once personnel are in place, create a charge or MOU. This will require understanding local data governance challenges as well as identifying applicable policies. Answering the following questions will help determine the direction for the group and establish priorities:
- What problems have previously surfaced around research data?
- Are there any gaps in institutional research data policy or procedure?
- Where do researchers need additional support to handle data securely, legally, and ethically?
- What new or modified funding policies need to be addressed at the level of the institution?

The frequency of meetings will be determined by local culture, though we recommend meeting at least once a month. Each meeting should have an agenda and designated note taker, with centrally available notes. This enhances information sharing and allows for historical tracking of when decisions were made or ideas introduced. Finally, develop a process for regularly communicating information to all stakeholders.

COOKING METHOD

Data governance is a low and slow cooking method, where ideas meld together and evolve over time. When approaching data governance for open science, it's helpful to start with a project plan with iterative phases and goals. This allows you to recognize early targets and make additions and changes along the way. Be ready to improvise and adapt as ingredients change over time.

Engage faculty and leaders to discuss policy and procedural gaps. Connect with outside resources like professional organizations and peers who have been engaged in data governance work to share practical strategies, common mistakes, and identify potential champions outside your institution.

At many institutions, traditional governance arises from information technology units. However, the nature of research data and open science projects broadly expands the stakeholders whose voices will need to be centered in the development of policies, processes, and procedures. Early and consistent advocacy to represent myriad voices will assist in ensuring everyone's ability to participate and comply with appropriate regulations and responsibilities.

As you are cooking data governance, it is also critical to document the often unrecognized labor across the institution related to data collection, storage, preservation, and sharing. By acknowledging this work, there are opportunities to advocate for improved staffing, provide appropriate recognition of labor, and manage expectations related to governance goals and initiatives.

CHEF'S NOTES

The community context of governance influences both goals and processes. Because this context varies by institution and work-

ing groups, cooks should maintain a broad awareness of the landscape to monitor potential allergens. External requirements—from funders, scholarly publishers, and state and local laws, for example—can interact in unanticipated ways. These conflicts often require creative community-based solutions that no single team can address in isolation. Conflict may also arise when external processes are adopted internally without community coordination. In particular, the expectations for institutional ownership and control of research data and associated policies and processes are often in direct opposition to emerging best practices for community-controlled governance by protected groups, such as the CARE Principles for Indigenous Data Governance (Global Indigenous Data Alliance, 2019).

No single team or unit possesses all of the expertise or knowledge to govern research data across the entire data lifecycle. This problem is compounded by the siloing of institutional offices and layering of institutional bureaucracy, which separates data experts from one another. Fostering communication across these traditional silos of expertise requires a shared space (a community kitchen), where such teams can come together. The largest challenge, and the most important outcome, of initiating data governance is to build the network of people to implement data governance.

When considering how to measure the success of research data governance initiatives, it is important to recognize that governance does not lend itself to traditional assessment strategies. When research data governance is done well, it prevents bad things from happening. While it is possible to measure decreases in undesirable outcomes or activities, this approach will not capture emerging risks. Avoid developing easy metrics that are disconnected from key governance activities. In general, the most important aspects of governance are not easy to measure, while the easiest things to measure are not the most important.

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Operating a Budget-Friendly Open Publishing Buffet

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NUTRITION INFORMATION

Offering new library services often requires adjustments to staffing, a budget increase, or both. Creative collaboration across different units can help small and mid-sized academic libraries build a portfolio of open publishing services without straining limited resources. This recipe uses the open publishing services developed at the Colorado School of Mines as a model to demonstrate how any library can create a buffet of offerings that support a variety of open publishing needs across campus.

This recipe is best implemented as a collaboration between librarians who specialize in different areas of the library, including scholarly communications, institutional repositories, collection management, and instruction. Like a buffet has an assortment of dishes, open publishing has a variety of components, including an open access (OA) publishing fund, transformative agreements with publishers, the institutional repository, and an open educational resources (OER) development program. The components of the buffet function best when the library is able to bring them together to support the varied open publishing needs of the campus. Through instruction, outreach, and reference services, faculty and students can be matched to the open publishing tools and services that best suit their needs.

LEARNING OUTCOMES

Cooks following this recipe will be able to:

- assess their institutional context to find opportunities to support open publishing despite a limited budget and/or limited staffing;
- explain how different service areas of the library can cooperate to support the open publishing needs of an institution; and
- evaluate their own open publishing initiatives to consolidate them into a cohesive offering.

NUMBER SERVED

Best suited for small to mid-sized institutions (4,000 to 10,000 students) but can be scaled up or down as needed.

COOKING TIME

Like a good whiskey, this buffet could take time to age properly. Expect to spend one to two years conducting needs analysis, establishing relationships, and growing the program.

DIETARY GUIDELINES

This recipe helps libraries determine which services would be best to include in an institutional open publishing buffet. This recipe will especially appeal to readers who are interested in offering open publishing options despite constrained budgets or limited staffing.

INGREDIENTS AND EQUIPMENT

An open publishing buffet can include any of the following:

- **Open access publishing funds**—common library initiatives to help faculty with the cost of Gold OA article processing charges (APCs). While many faculty write support for APCs into their grants, those who are conducting research without funding or have expanded the scope of their research and publications beyond what was included in their grant proposals are often left without financial means to publish openly. Even relatively small amounts of funding can help make OA publishing a financially viable option for more researchers. We started our program with a campus innovation grant of $20,000 per year for two years, which paid for Gold OA APCs for about twenty papers each year. Since then,

the library has funded the program at $5,000 per year.

- **Transformative agreements**—an umbrella term that, for the purposes of this recipe, refers to agreements between institutions and publishers to expand open access publishing opportunities. Dive in and get familiar with the many existing transformative agreements from publishers as well as the terminology used to spice up each dish. Read *The Scholarly Kitchen*'s primer on transformative agreements (https://scholarlykitchen.sspnet.org/2019/04/23/transformative-agreements/) if you aren't sure where to start.
- **Institutional repositories**—depending on the size of the institution and the type of information that will go into the repository, a university library will often use one to three software platforms to house the content. For example, research reports and articles that are PDF documents might be best served from a traditional document repository platform, such as DSpace or Figshare, while images or special collections materials might be best presented in a repository that has a nice graphic interface, such as CONTENTdm or Digital Commons. These platforms are also called vendor-based systems, or VBS (O'Brien, 2023).
- **OER development programs—**there are many state and national grants to encourage OER development and adoption. Where it is an institutional priority, institutions may also support OER development programs. Tapping into these funding sources can allow institutions to incentivize faculty to create, adopt, and adapt OER.

PREPARATION

Prepare to cook any or all of the above buffet elements by following the instructions below.

Before establishing an OA publishing fund, examine institutional context. Answer these questions to decide how to allocate resources and how to build a program to fit institutional needs:

1. What journals are researchers at your institution using and publishing in?
2. Would pursuing transformative agreements be a better use of a limited budget?
3. What is the appetite on campus for OA publication?
4. How much research is being conducted outside of grant funding?

Before undertaking transformative agreements:

1. Examine the library budget to determine the amount of funding that can be allocated towards transformative agreements.
2. Familiarize yourself with where members of your institution are currently publishing.
    a. Some vendors may be able to supply reports of published articles and books, and
    b. Information may be available from databases such as Scopus or Web of Science.
3. Conduct basic research to see if the most used publishers offer transformative agreements.

Before establishing or overhauling an institutional repository:

1. Conduct a needs analysis to determine what the organization needs and wants in a repository. This process might take one to two years depending on institutional complexity. Consider:
    a. what content you would include,
    b. how much interest faculty and students have in depositing their work in the repository, and
    c. what file types and sizes you will need to accommodate. For example, will the repository also hold data for researchers? Or is it just for documents, images, videos, etc.?
2. Determine if it is better for your institution to hire staff to develop and maintain a repository or if it would be better to outsource to a hosting company. To locally host your own repository, you might need to hire technical staff. You also might need to purchase several TB of storage space.

There is no such thing as a free lunch. Even though OER are free to use and share, they are not free to produce, so before launching an OER development program:

1. Explore interest in OER use and development at your institution.
2. Determine if OER is an institutional priority and if funding could come from within the institution.

   a. If not, look for external funding opportunities. There are numerous charitable foundations, government agencies, and international organizations interested in the development of high-quality open resources.
3. Be prepared to lead grant efforts. Libraries, as the centers of publication distribution, are well situated to spearhead efforts toward OER development through facilitating the pursuit of grants.

COOKING METHOD

Once you're ready to assemble your buffet, remember that consistent communication with co-chefs is very important. You might be coordinating with multiple chefs across units in the library and across campus.

Assess the needs of your community and balance them against the capacity of your library. Consider how customized you would like to make each component of the buffet; more customized elements may require additional work and support.

Plan how the library will advertise the buffet, and coordinate with your co-chefs and fellow library staff to ensure consistent and accurate external communication and avoid duplication of efforts. Coordinate data collection and assessment efforts across the buffet to limit waste and ensure that data will be cohesive, particularly in cases where funders will require reports and updates.

Finally, remember to monitor budget and appetite at regular intervals, then adjust as needed.

Additional tips for serving up OA publishing funds include:

1. Fund those who don't have grant funding for APCs as your first awardees.
2. Limit initial scope based on available budget. For example, $500 per institutionally affiliated author up to $1,000 or the cost of the APC. The budget doesn't have to be huge to encourage OA publication.

Establish and maintain transformative agreements by:

1. contacting publisher representatives with whom you have an existing relationship to evaluate options;
2. contacting publishers with whom you may not have a relationship but would be good candidates for transformative agreements based on publishing trends at your institution; and
3. annually evaluating transformative agreement offerings, including:
   a. funding to support the collection, these agreements, and publishing at your institution;
   b. new offerings of transformative agreements from publishers; and
   c. changes in preferred publishers at your institution.

When establishing an institutional repository:

1. Determine how many administrators you will need and who they will be. For example, at Colorado School of Mines, there are two main administrators of the software platform (DSpace) and a third backup.
   a. Determine which library staff positions should be involved in the development and maintenance of the repository, and
   b. consider establishing a committee to support the administrators in their work.
2. Establish a license with a repository vendor or build your own.
3. Set up procedures and workflows for adding content in batches and/or migrating content from other systems.
4. Begin adding content by starting with the highest institutional priority.
   a. This could include OA and OER content that was funded by the library.
5. Establish a self-deposit procedure if you would like community members to contribute their own work.
6. See Finlay, 2021, and Wesolek et al., 2016, for more resources and ideas.

In order to launch an OER development program:

1. Determine funding tiers. Consider different amounts based on the effort required, such as $500 for adopting an existing OER, $750 for adapting an existing OER, and $1000 or more for creating a new OER.
2. To make the highest impact with the least amount of money, start with core, high-enrollment courses, which tend to have many existing OER textbooks and other resources, enabling less intensive adaption and adoption efforts.

1. Develop a research guide or webpage with existing OER collections and development tools.
2. Consider how you will address accessibility issues in existing OER or when developing new OER.
3. Be prepared to support OER creators as they develop their materials. This might include navigating copyright and licensing, identifying the best platform for hosting, and remediating accessibility issues.

CHEF'S NOTES

There are a lot of appetizing initiatives in open science; be careful not to overfill your plate, or things can get messy. Only take on what you can realistically manage.

As with any funding program, OA publishing requires institutional support. If possible, use program participation metrics and APC costs to convince university administrators to increase the OA publishing budget.

As with any vendor offering, when it comes to transformative agreements, be wary of the upsell and know when to walk away. If you have the available budget, this can be a financially savvy to expand access as well as gain a transformative agreement. . Leverage your actual usage and publishing numbers when negotiating. Consider all vendor offerings to find the best deal. Look for offers via consortiums, which can offer more favorable terms than solo options; multiyear contracts can also offer savings. Vendors often make deals toward the end of the calendar or fiscal year; aim for a timeframe that may come with a discount.

If an institutional repository isn't in the cards for your institution, or if it doesn't suit the needs of some researchers, you can assist faculty with depositing their work in a general repository, like the Open Science Framework, or a disciplinary repository like arXiv.

Finally, given that grant funding can be unreliable, building support and momentum in the early stages of an OER development program development can help carry OER initiatives through periods of little or no funding. Use small incentive grants as an appetizer to help develop relationships with potential partners for larger scale projects. Whether funding grows or not, as with all institutional initiatives, building connections is essential.

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Section 2.

Instruction

Spicy Data Skills Open Science Program With Library Carpentry

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NUTRITION INFORMATION

This recipe describes how to adapt openly licensed materials from the Library Carpentry (https://librarycarpentry.org/) curriculum to develop a data skills program that works for your individual institution. Librarians may be most comfortable exploring Library Carpentry first before expanding into Data Carpentry (https://datacarpentry.org/) or Software Carpentry (https://software-carpentry.org/), depending on their campus needs. The Library Carpentry curriculum differs from other Carpentries because it caters to the knowledge and skills of librarians. A good example is how to apply Tidy Data principles to historical dates or the lesson about 'Introduction to Data for Archivists'. All instructors receive the same 16-hour train-the-trainer certification, whether Software, Data or Library Carpentry. Each workshop's content is tailored with data files recognizable to that audience (Ecology and farms, MARC or Grateful Dead discographies, Data Management in SQL for Ecologists, R for Reproducible Scientific Analysis). Then learners can see data they are already familiar with to transfer the skills to current problems at their jobs. This recipe focuses on Library Carpentry but can also be applied to Software Carpentry (for research programming skills) and Data Carpentry (for research data structure best practice).

Academic libraries that are members of the Carpentries serve locally customized menus of instruction and professional development on computing and data literacy. The Carpentries support open science initiatives through librarians becoming instructors in a train-the-trainer program. These are often facilitated in collaboration with university-based science disciplines and early career researchers, especially graduate students. By using open-source software, such as OpenRefine, and removing barriers created by proprietary software, the Carpentries are strongly aligned with open science principles. Carpentries' materials are available for use under license (https://carpentries.org/license/), which means that individuals are able to use, share, and adapt material improvements to their own practice and share this learning with colleagues, with attribution (http://creativecommons.org/licenses/by/4.0/).

Carpentries lessons are scalable, customizable, and available to support outreach and collaboration across a range of organizations, including resource-limited institutions. A broader Carpentries community of cooks also provides continued professional development support for instructors and facilitates the creation of new open educational resources (OER) and adaptations on the basis of inclusion, accessibility, and local languages. By hosting the lessons in GitHub under a CC-BY-4.0 license, the materials meet OER definitions. Several are already translated and maintained in Spanish, with other translations in the works. Students and instructors can provide feedback on every lesson page to report errors or suggest improvements.

Cooks may already be familiar with the previous ACRL cookbook recipe "Software Carpentry Al Dente" (Ossom-Williamson et al., 2022), which explains how to cook a single Carpentries workshop. Here, we put greater focus on development at the program level and describe how Library Carpentry can be selectively adapted for developing a spicy

open science data skills program at your academic library.

LEARNING OUTCOMES

After following this recipe cooks will be able to:

- engage Library Carpentry materials to advance an open science program and support professional development for researchers, librarians, and other university staff;
- identify and explain a Library Carpentry workshop and its relevance, describe its available OERs, and find and access its community, including a network of trained volunteer instructors;
- advise colleagues and peers how to leverage existing networks and infrastructure to customize aspects of Library Carpentry (batch cooking vs. cooking for one); and
- adapt existing Library Carpentry lessons and principles to the local context and institution.

NUMBER SERVED

Each meal can yield infinite servings. Chefs can scale up as audience appetite grows and feed entire labs, departments, even colleges (Gofman, 2019). A chef can also produce these meals at a small scale, for a library staff leveraging many classes with limited personnel, for example.

COOKING TIME

Improving your library staff's capacity to support FAIR (findability, accessibility, inclusion, and reproducibility) data principles (OpenAIRE, 2023) and open science is not a quick fix. Major funding bodies increasingly require the research they fund to be findable (with a persistent identifier), accessible (online), interoperable (applying common file format and standards), and reusable (well documented and licensed). It may take months or years to connect and collaborate with your colleagues and peers, apply for and win funding, to advertise and recruit. Like a barbeque, you will need a long, slow heat to get a maximum return.

In the short term, create interest at staff orientations or introductions by combining Carpentries' OER with networking appetizer lessons like Tidy Data (Wickham, 2014). In the medium term, get buy-in by spending time with new chefs to develop recipes and data sets in a local context.

Table 1. *Detailed Cooking Times for Supporting an Open Science Program*

Workshop segment	Steps	Length of time
Start-to-finish	Planning and delivering a workshop, including sourcing guest instructors.	2 months, typically
Installation party (pre-workshop set-up)	It is crucial to have time for participants to install the relevant software they will use in the session if they are to use their own computers	This could be a drop-in hour, ideally face-to-face
The workshop itself	Delivering a single, official Library Carpentry workshop.	4 days of 4 hours each, though you can be flexible
Following up after a workshop	To measure participants' engagement and support them to apply what they have learned to their individual roles and data sets.	A further 3 hours
Putting your staff through the Carpentries instructor training program	They can continue to deliver workshops without using guest instructors	2 full days
Leftovers (follow-up session)	The follow-up session will be incredibly useful for your participants to retain their new skills and improve their workflows so that their outputs are more reproducible, transparent and shareable. Outcomes and feedback about the andragogy, the snacks, next steps for continuing or revising, celebrating good instructors and providing thoughtful training and preparation materials	Half to a full hour

In the long term, individuals developing open science programs at their institutions may want to consider advancing a curriculum which maps to course work expectations across generations. See Table 1 for details about cooking times for supporting an open science program.

DIETARY GUIDELINES

Carpentries' curricula and resources offer pedagogically sound, ready-to-use content on data skills, research computing, and information literacy. These skills may be easily overlooked or rushed in formal classroom environments and self-studies. Information is also provided in an easily digestible format for a novice learner audience. Carpentries resources support recommended practices and save librarians from having to develop custom content or work with researchers to retroactively convert wild data into tidy formats. Librarians deliver Carpentries workshops to broad audiences, including research support staff and administrators, and incorporate relevant, meaningful examples and use cases to customize the content. This may include examples about how technical skills can be applied to systems, workflows, processes, and funding proposals to further the goals of open science.

INGREDIENTS AND EQUIPMENT

Assign the following roles (see figure 1) to your team of kitchen staff:

- one sous chef to coordinate and justify budget and time;
- one short-order cook, often from IT, to troubleshoot in the moment;
- two or more prep cooks who are interested in learning the material;
- one food critic to critique materials and make suggestions for tailoring to local ingredients and context;
- two or more farm-to-table vendors, who represent instructors or faculty members who oversee learners in need of scaffolded and customized coding instruction (like undergraduates) and individuals who may be in need of pedagogical support (the next generation of Carpentry instructors);
- one caterer or delivery driver to host logistics, whether you provide a large-scale, in-person training, a completely remote training, or a range of hybrid alternatives;

Figure 1. Scene from a workshop, modified image from The Carpentries' Instructor Training (CC-BY 4.0), https://carpentries.github.io/instructor-training/.

- one host to oversee everything from registering with the Carpentries to hiring an instructor, arranging space, and managing registration; and
- one busser to clean up outputs and files and pack up leftovers.

Your kitchen will require the following utensils and ingredients:

- a space for learning with minimal distractions
- computers, ideally with a second monitor (one per learner)
- administrator access to install software
- shaped sticky notes or high-contrast color cards and pens
- a projector or large screen for the room to see live coding clearly
- internet access to support downloads and software installation or an offline setup (https://carpentriesoffline.org/)
- electrical power supplies or sufficient battery backups
- printer or other means of providing access to pre- and post-workshop surveys and other materials that need to be delivered in hard copy

PREPARATION

Before cooking this recipe, make sure to read "Software Carpentry Al Dente" (Ossom-Williamson et al., 2022), which introduces readers to the Software Carpentry open source curriculum and defines instructor and participant workflows, including confirmation of availability, outreach and engagement, event preparation, and teaching and learning.

In addition to carrying out the preparation described by Ossom-Williamson et al., who informed the design, development, and implementation of our recipe, cooks implementing Library Carpentry or similar curriculums in support of open science should also consider the following:

- Identify the learning needs of your audience. What skills do they already have; what do they claim to need; what do you think they need? Use this information to tailor and adapt the lesson materials to your local context.
- Are there any qualified Carpentry instructors at your institution? What about at nearby or partner institutions?
- Discover local assumptions or presumptions that may contribute to barriers. What perennial complaints about knowledge gaps ring in the halls? These can help you to identify which workshop to request and, within that workshop, which elements to emphasize or skip.
- Will sessions be scheduled as two full days or four half days? Learners may prefer a gap between sessions to keep up with their regular work commitments.
- Will instruction be delivered virtually, in-person, or in a hybrid setting? Consider that virtual sessions and hybrid sessions are more labor and time intensive and may not be suitable for novice learners.
- How will faculty or students receive credit for completion? What will qualify as completion?

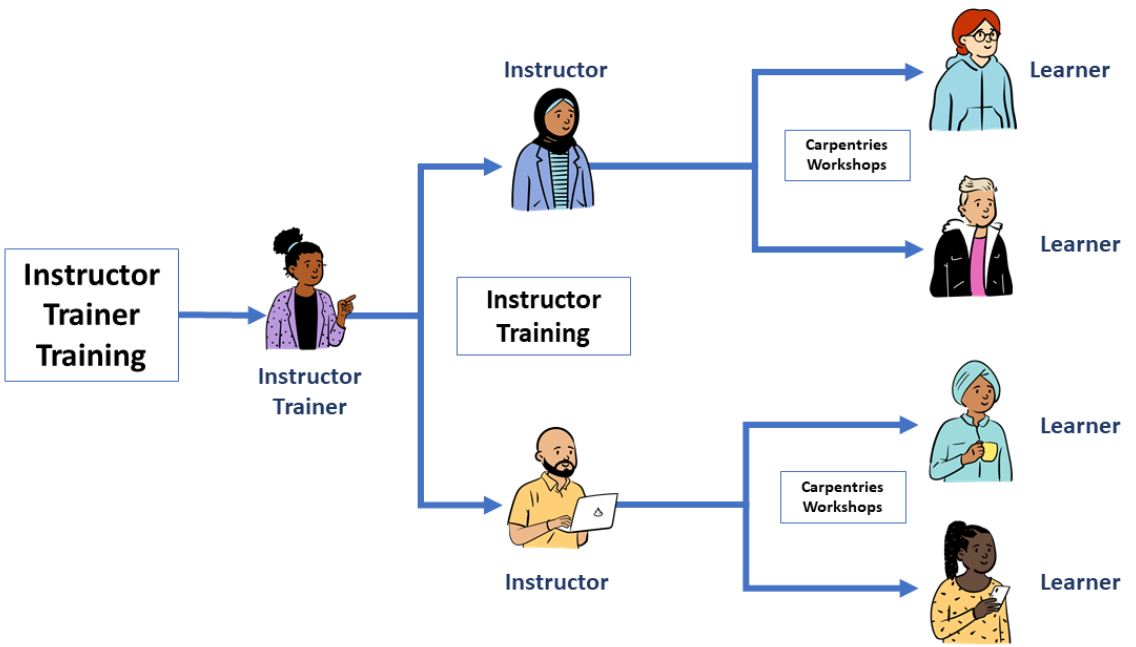

Figure 2. Local communities, from The Carpentries' Intro to Midwest Carpentries Call, September 2023 (CC-BY 4.0), https://docs.google.com/presentation/d/16NlqEKAMfaZgC_ZOGYiD1h6uUdFV1u-1IDi7pbdwHhE/edit#slide=id.ge267fc051b_0_107

COOKING METHOD

Our recipe extends and updates Ossom-Williamson et al by providing a quick reheat before deglazing additional details about how to cook up spicy data skills in support of an open science program (see figure 2):

- One, sort beans and remove sand. Instructors should convene to coordinate tasks, assess learners' needs, and make key decisions about the delivery of the workshop's curriculum, relevant topics for instruction, and teaching assignments.
- Two, pre-soak. Sign up with Carpentries' centrally organized workshops (https://amy.carpentries.org/forms/request_workshop/) to recruit instructors and coordinate and recruit additional volunteers to ensure adequate staffing.
- Three, prepare a menu through advertising. Finalize logistics, including dates, times, locations, advance registration requirements. Consider available technologies, and anticipate potential challenges.
- Four, shop for ingredients. Instructors explore the local culture which may include discussing specific learners' needs, preferred styles, languages, and accom-

modations.
- Five, arrange deliveries. Instructors select lesson elements to emphasize or skip.
- Six, receive deliveries. Instructors decide key logistics related to the workshop dates, times, spaces, advance registration requirements. Consider available technologies and anticipate potential challenges.
- Seven, promote the workshop. Coordinate with relevant departments and communications staff members to prepare and distribute customized messages and outreach materials.
- Eight, distribute pre-workshop surveys to learners, collect results, and share with instructors and organizers.
- Nine, host a pre-install party! Meet with learners in advance of the workshop to provide assistance and instruction on installing any required software applications. Make sure you are prepared to support learners of varying technical abilities and experience, both at the pre-install party and during the workshop.
- Ten, host the workshop.
- Eleven, serve the fruit and cheese course: Solicit learners' feedback.
- Twelve, clear the table. Debrief and discuss the workshop implementation process and survey feedback with fellow instructors/organizers. Use feedback to plan for adjustments in future programming, in both workshop content and form.
- Thirteen, host an after-party or picnic! Instructors can maintain momentum for an open science program by coordinating future, related workshops or adjusting ratios and seasonal spices and delivering the same menu to a new audience.

Virtual (online) or hybrid workshops are possible, but require the most of prep cooks. It is much more difficult to diagnose and resolve problems relating to software installations. Learners must be comfortable with webinar software and multitasking windows which can be a significant cognitive load for novice learners who may be intimidated by statistics or code. Virtual sessions require additional set-up and prep-time of about one or two days in advance and/or the use of personal equipment, depending on local IT lead time. Hybrid workshops have been reviewed at the UK Carpentries monthly discussions (https://hackmd.io/@local-uk) with consensus that they are the most challenging for all.

Additional care and consideration may be necessary when working with diverse learners, particularly those from non-STEM fields. For example, arts and humanities researchers may be comfortable working with a diversity of specialized materials and file formats (e.g., maps, digitized papyrus fragments, etc.), which may not be explicitly incorporated in the Carpentries workshops. These researchers may be examining art, artifacts, or objects using estimated date ranges spanning thousands of years and with archaic languages. These diverse learners might use different vocabularies to identify and describe the concepts in the Carpentries materials.

In terms of diversity in technical experience, consider supporting advanced learners with supplemental exercises, workshops, or courses. You can also challenge advanced learners to adapt to the question to their current experience. You can support novices by modifying instructions or vocabulary, using foundational exercises, providing more hands-on support during the workshop, and offering supplemental coaching or consultation sessions.

CHEF'S NOTES

The audience for Carpentries curricula is far wider than librarians alone. Several of this recipe's authors (based at the University of Manchester) have taught Shell and OpenRefine lessons for a graduate program in library and archive studies. Oliver et al. (2021) describe Library Carpentries lessons integrated into health, data, and information science programs in Europe and the United States. Cope et al. (2020) describe how digital skills and development have been improved across the library sector in the United Kingdom. In both cases, personnel included metadata and information specialists, institutional IT professionals, research data management teams, and digital humanists. Consider a wide range of job titles and professional areas when planning Carpentries workshops, including research administrators, grant writers, integrity officers, communications staff, human and animal subjects coordinating staff, adminis-

trative staff, and senior executives.

Robinson and Lowndes (2022) say that one critical and overlooked aspect in the journey to open science is to gain support from managers and leaders. They do not need to be experts in open science but leaders who support their teams and make strategic decisions about investment, training and innovation. In collaboration with NASA, Robinson and Lowndes developed the Openscapes Flywheel, which is a "framework for managers to facilitate and scale inclusive [o]pen science practices" (2022). They have already seen the ways in which adopting open science strategies have increased findability, accessibility, inclusion, and reproducibility in research at government, academic and non-profit organizations.

HOW TO ADAPT THE RECIPE FOR REPRODUCTION

Reflective chefs will review individual elements' contributions to local program replication. Collecting diners' feedback can refine and facilitate localization of later reproductions. Here are some suggestions for how chefs may wish to adjust the recipe on subsequent bakes.

Depending on the feedback received in workshops throughout the program, emphasize certain botanicals through relevant examples or real-world applications of materials to evidence the value of learning tools and methods. Skip the soup: when undertaking data cleaning for individual, stand-alone projects skip the version control episode. Adjust to a picnic because of a rainy day: switch workshop duration/format. Extend the timeline to accommodate different learning styles or family/life balance needs; adapt content to hybrid or more accessible venues.

To support advanced learners, add a souffle course of extra exercises, workshops, or courses (challenge diners to adapt the question to their current research); extend the menu by developing intermediate or advanced Carpentries lessons or additional supplemental open educational content (see Additional Resources for details). Bring your own (spices) data to bring the experience home within and across existing workshops.

To support novices across the program's menu, add foundational-level exercises (pureed food, applesauce, creamed peas). Offer supplemental coaching or consultation sessions to support data literacy (chopstick holders, dietary or nutritional counseling between workshops). Give extra explanation, paraphrase (alternative condiments). Give diners an opportunity to complete the exercises / work with them (fork vs chopsticks).

We leave you with a few tips to make #Open a daily staple of your diet:

- Write email content using Markdown.
- Save spreadsheets as CSV files.
- Store data in institutional repositories.
- Use open educational resources.
- Make data tidy; use a codebook.
- Highlight incremental changes to existing workflows, curricula, and engagements for learners to apply open science skills daily.
- Maximize opportunities for individuals across the institution to adopt and reinforce open science principles and practices—to minimize allergic reactions.

ADDITIONAL RESOURCES

- Multiple ways to follow up after Carpentries training, https://carpentries.org/blog/2023/01/multiple-ways-to-follow-up-after-carpentry-trainings-benefits-impacts-and-librarians-wishes/
- How to create a carpentry lesson, https://carpentries.org/blog/2023/10/cldt-curriculum-and-trainers/
- The Carpentries instructor training curriculum, https://carpentries.github.io/instructor-training/
- The Carpentries Handbook, https://docs.carpentries.org/
- Join the conversation, https://carpentries.topicbox.com/groups/community-development
- Library Carpentry lessons, https://library-carpentry.org/lessons/

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Undergraduate Chefs Dishing Reproducible Research

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NUTRITION INFORMATION

With the growing adoption of open science practices and tools, research is becoming more transparent and reproducible, resulting in increased credibility and quality. There are many open science tools that help organize lab notes, protocols, and code for open dissemination, but how confident are student researchers in using these tools in the context of reproducible research, and how can they see the value of using them without experiencing the benefits that open practices bring to the research community?

This is a recipe for a course that introduces students to the fundamentals of research and demonstrates the benefits of open, transparent, and reproducible research practices.

LEARNING OUTCOMES

Upon completion of this recipe, instructors will be able to:

- create lessons that simultaneously teach research fundamentals and open, reproducible research practices;
- find and use open resources that facilitate learning about open science and research; and
- prepare simple examples that let students practice research and understand reproducibility best practices.

NUMBER SERVED

This recipe, which can be prepared and served by a single chef, delivers a highly engaging course to four to twelve students.

COOKING TIME

This recipe can be used to design an eight- to twelve-week course (a regular academic semester or a summer semester). Plan for at least four weeks to prepare materials before the class begins.

DIETARY GUIDELINES

This recipe helps elevate introductory research education for undergraduate students by integrating modern, open practices and considerations of equity, transparency, and reproducibility to the scientific method and the research lifecycle.

INGREDIENTS & EQUIPMENT

Before you begin, you will need:

- an existing research methods course, a need for such a course, or an open call for research-based courses (a broad audience is best, but you can adapt for a department or discipline-specific course);
- a learning management system, such as Canvas, to manage grades and communication with students;
- a collection of open educational resources that are accessible, open source, and potentially maintained by collaborative communities (see Additional Resources below for examples);
- a project page for the class on Open Science Framework (OSF); and
- samples of research that include simple datasets and code for analyses (see Preparation below).

PREPARATION

The course will be organized into scaffolded modules. As the class progresses through each module, the content should narrow towards the specific tasks and tools used along the research lifecycle and the corresponding open science practices that enhance reproducibility.

With that in mind, consider the following sequence of modules to cover research, open science, and reproducibility with a general-to-focused approach:

1. the scientific method
2. the research lifecycle and scientific publications
3. open science and research
4. reproducibility

Materials in these modules may include lecture slides, homework assignments, reading material, and references. Computers and simple coding problems are the perfect lab bench for this recipe. Let students practice research with simple programming and data

science. Introduce open-source programming languages like R or Python. Consider teaching lessons created by The Carpentries, which include great examples of problem solving with programming and data.

As students become comfortable writing code, introduce version control and good practices to enable computational reproducibility. Consider incorporating abbreviated modules like open source programming for data analysis and research and version control and computational reproducibility.

For best results, deliver the lessons and exercises from these modules in parallel to those in the main modules. This will give students more time to get comfortable with programming and other computational research skills through the entirety of the course.

Walk students through the research lifecycle with examples of the products created at each stage. Find or create these examples based on an overarching research topic or idea. For best results, choose examples with an easy-to-follow hypothesis for students to explore with the resources at their disposal.

1. Select publications that provide background on the research topic, and create sample bibliographies.
2. In each bibliography, include examples of research publications with different levels of accessibility.
3. Create sample research notebooks or individual notes with brainstorming, ideas, or observations from research articles.
4. Find or create example datasets related to the research topic that demonstrate different modes of data collection and sharing
5. Create an example of an analysis with the data above that employs code to generate visualizations
6. Document the process of data collection and analysis with recorded procedures or instructions.

Provide examples of products that are closed, inaccessible, or minimally prepared for shar-

Table 1. *Closed and Open Examples of Research Outputs*

#	Example Type	Closed Example	Open Example
1	**Bibliographies**	A simple list of titles or links, or a shared folder with arbitrarily named PDF files.	A machine-readable .bib file with rich metadata for each article, uploaded into a reference manager like Zotero.
2	**Article Accessibility**	An interesting and informative publication that is restricted with a paywall.	A research publication of similar scope that is free to view through an open access model.
3	**Research Notebook/Notes**	Handwritten, physical notes, looseleaf or in a notebook.	A shared collection of digital lab notes on LabArchives that are organized and detailed or notes in a personal knowledge platform like Obsidian, where ideas and thoughts are systematically organized and connected.
4	**Datasets**	A raw data file with little formatting and structure (consider choosing a proprietary format like .xlsx) arbitrarily stored in a GitHub repository or a shared folder.	A formatted and machine-readable data file (such as a .csv) archived in a generalist repository like Zenodo or an institutional repository, accompanied with a detailed README file.
5	**Analysis with Code**	A solitary script that uses data analysis tools from specific libraries arbitrarily stored in a GitHub repository or shared folder without information about dependencies, versions, or how to run.	A Jupyter Notebook, either in a capsule with a preserved computing environment in Code Ocean or hosted on Binder with all dependencies properly included in a .YML file in an organized GitHub repository.
6	**Procedures/ Instructions**	A brief summary of experimental steps, similar to what is normally listed in the methods section of a research publication.	A detailed outline of experimental procedure published on protocols.io.

ing to facilitate discussion about limitations and challenges around closed research. Then, provide examples of the same products that are open, accessible, and thoughtfully prepared for sharing (potentially hosted on an open and secure platform) to discuss the advantages of open research. (See table 1.)

Finally, create a page on Open Science Framework (OSF) for the class. This can also be used as an example to show the advantage of using an open and collaborative project management platform as opposed to something like a shared team folder. Create components on this OSF page for each phase of the research lifecycle. Under each component, create folders for each student to upload their own research outputs.

COOKING METHOD

Module 1: The Scientific Method

In these lessons, discuss each step with a broad mindset. The steps in the scientific method can be listed in various ways. For reference, here is one option:

1. make an observation
2. ask a question
3. form a hypothesis
4. do background research and identify variables
5. do experiment(s) to disprove hypothesis by testing variables
6. analyze results
7. make conclusions
8. iterate

Begin to introduce reproducibility by addressing how ideas and information can be recorded and preserved at each step. For example, highlight how notes are taken and shared and what is done with observations, measurements, and data. Emphasize that by making these records, ideas and discoveries become reality.

Module 2: The Research Lifecycle and Scholarly Publications

This module should illustrate the process of creating and disseminating research. Consider framing the discussion by pointing out that in the scientific method, steps one through four involve research planning, steps five and six involve collecting and analyzing, and steps seven and eight involve making decisions and determining next steps.

Present the four stages of research, which can be described in a number of ways— for example: (1) designing and planning, (2) collecting and analyzing, (3) publishing and archiving, (4) impact and reuse—and ask students to identify skills (which they may already have) that facilitate each stage.

Introduce reproducibility by discussing how ideas, workflows, and results and products can be recorded, preserved, and shared at each stage. For example, have students consider the ways that research plans, analyses, and publications can be saved, preserved, and shared. Ask students to anticipate consequences of not sharing or preserving at different stages. Discuss each consequence as a class, and eventually narrow in on the concepts of reusability, reproducibility, and replicability.

Module 3: Open Science and Research

First, introduce open science by providing a definition and discuss the latest developments happening around the world. Then, highlight specific open practices and showcase some tools or platforms. In the lessons following, show how these open practices and tools fit at each stage of the research lifecycle, making each piece and product more open, accessible, transparent, and reproducible. For example, you might explain how sharing publications is linked to open access and sharing data and code is linked to open data and open source software. Use these lessons as an opportunity to outline resources, services, and workshops offered at your institution. Demonstrate how core values link to open science. Ask students to map values to an open practice of their choice.

Module 4: Reproducibility

First provide a broad summary and definition of reproducibility in research. Then ask the class to recall discussions from the second module about the consequences of not sharing or preserving pieces of research. Point out how these factors prevent reproducibility, and show how open practices can encourage reproducibility. In one lesson, outline common barriers that researchers encounter when creating reproducible research. Ask students to choose a barrier and brainstorm how to approach it.

CHEF'S NOTES

Give students opportunities to reflect and learn outside of class by assigning simple

reading reflection exercises as homework. (See Additional Resources.)

In parallel to the main modules, teach students the basics of an open-source programming language like Python or R, version control, and basic best practices in computational research. Consider using the last third of each class session to teach these topics, so that students have the entire span of the course to refine these skills. Provide interactive exercises in class and assign exercises for homework.

Give each student the opportunity to explore their own research topic, or let them expand on the topic presented to the class. This project will give students practice in creating open and reproducible research products, which should be the main deliverables for the course. Ask students to create their own versions of each open example along the research lifecycle, related to their research topic or their extension to the class topic. Be sure to provide the students time to sharpen these skills and make products that they are proud of. For instance, you may assign each research product deliverable after showing examples in class.

Aim for all deliverables to be turned in before the last few classes so that the class can hold their own research symposium. Give each student a five- to ten-minute time slot to present information about their research project, then create breakout sessions for students to evaluate each other's research for reproducibility and adaptability. At the end of the symposium, hold an open discussion for students to reflect on what they learned in the course and their overall experience in creating open research products.

Make sure that all students, if they are willing, upload copies of their research outputs to the class OSF page. This could lead to an excellent portfolio of open research examples that can continue to grow with further iterations of the course.

ADDITIONAL RESOURCES

The Hagen Cumulative Science Project (Jekel et al., 2020) integrated open science principles into undergraduate curricula in psychology with replication-focused theses.

For adaptable materials that fit this recipe, such as lecture slides and assignments, see the Reproducibility Class 2023 project page on OSF (Griego et al., 2024).

Resources for hands-on, reproducible research practice:

- Open Science Framework (OSF), https://osf.io/
- Software Carpentry, https://software-carpentry.org/lessons/
- Data Carpentry, https://datacarpentry.org/lessons/
- LabArchives, https://www.labarchives.com/
- Obsidian, https://obsidian.md/
- Code Ocean, https://codeocean.com/explore/
- Binder, https://mybinder.org/
- protocols.io, https://www.protocols.io/

Suggested material for reading reflection assignments:

Carpi, A., & Egger, A. E. (n.d.) The practice of science: An introduction to research methods. Visionlearning. Retrieved November 11, 2023, from https://visionlearning.com/en/library/Process-of-Science/49/The-Practice-of-Science/148

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Creating a Buffet of Open Datasets and Case Studies for Appetizing Data Science Instruction

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NUTRITION INFORMATION

This recipe offers a practical, collaborative solution for developing curated, ready-to-use open research materials that will whet learners' appetites for data science. The approach involves forming a "cooking team," or a partnership among library staff, data science faculty, and students, to create and share a buffet of open datasets, representing a variety of topics and sources, and data pipeline case studies that demonstrate how to clean, analyze, visualize, and share data.

Through the collaborative process of planning and creating the buffet, cooking team members deepen their own understanding of how to find, evaluate, select, and curate datasets that are suitable for a wide range of learners.

LEARNING OUTCOMES

By following this recipe, the cooking team will be able to:

- describe considerations for optimizing collaboration among library staff, data science faculty, and students;
- identify the steps and tasks involved in initiating, planning, and creating a buffet of curated open datasets and case studies; and
- evaluate options for sharing in a digital repository.

NUMBER SERVED

This recipe requires four to six cooking team members who are actively involved in the project. The recipe serves an unlimited number of people, as the end product is widely accessible to library patrons and other learners.

COOKING TIME

Plan to spend approximately six months on this recipe, including three months of preparation: one month to form the cooking team, set goals, and provide training as needed and two months to formulate case study research questions, identify appropriate datasets, and determine specific analyses that will be applied to answer the research questions.

Cooking and serving require an additional three months: two months to clean the data, conduct analyses, summarize results, and create metadata and one month to identify a suitable repository, review repository requirements, compile all materials, and share the materials.

DIETARY GUIDELINES

Data science education relies on real-world datasets to increase student engagement and improve learning outcomes. However, incorporating real data when teaching data science poses major challenges for both librarians and faculty. Many suitable datasets are overused and outdated, while newer datasets often require extra cleaning and wrangling that is beyond the scope of an introductory course or library workshop. Another challenge is that widely available public datasets, such as the US Census and American Community Survey, can be intimidating to students without sufficient instruction and detailed data documentation.

This recipe addresses these challenges by using an interdisciplinary team approach to promote data literacy and open science practices, particularly those that are grounded in the principles of FAIR (findable, accessible, interoperable, and reusable) data (Wilkinson et al., 2016).

INGREDIENTS AND EQUIPMENT

In addition to a librarian who will serve as executive chef, the cooking team requires at least two "chefs" to serve as mentors for the

project. Ideally, the chefs will include at least one librarian and one faculty member in data science or a related discipline. The cooking team also involves "sous-chefs," or student researchers; each sous-chef will be paired with a chef. Obtaining funding will allow the chefs to recruit outstanding sous-chefs by offering a competitive hourly rate for participation.

A successful buffet hinges on a cohesive and collaborative cooking team. In addition to a strong partnership between chefs, the selection of sous-chefs is a critical component. Here are a few cooking tips to guide your selection process:

- Sous-chefs will have taken at least one course in data science, demonstrate passion for working with real data, and possess sufficient technical skills, such as Python or R programming experience, for basic data analysis and visualization.
- Previous experience working with government datasets for research is preferred but not required for cooking a basic dish. The importance of this qualification increases when cooking a more complicated dish involving a variety of ingredients from different government agencies.
- Previous data management experience is preferred, but strong interest in learning about data management is acceptable.

Other ingredients and equipment required for a delicious open data buffet include:

- open source software, such as Python, Jupyter notebooks, and RStudio
- an institutional repository or other open data repository
- open government datasets (see Additional Resources below for recommended websites.)

PREPARATION

- The executive chef begins by socializing with potential chefs on campus, such as other librarians and faculty in relevant departments (e.g., data science, computer science, computational research programs, research data services) to identify collaborators.
- Once a collaboration between chefs has been established, hold a planning meeting to establish goals, responsibilities, buffet dishes (deliverables), and deadlines.
- Identify desirable characteristics and qualifications of sous-chefs and create a job description for this role.
- Advertise the project and job description through student communication channels. If funding is available, clearly describe any requirements and limits (e.g., work eligibility, minimum and maximum number of hours per week).
- Chefs should interview eligible candidates and select sous-chefs based on consensus; this will contribute to a positive team dynamic.
- Hold an initial team meeting with all chefs and sous-chefs to review goals, responsibilities, deliverables, and deadlines.
- Suggested deliverables to be prepared by each sous-chef:
  - a clean, easy-to-access version of an open government dataset that is appropriate for beginners
  - one to two research questions about the topic of the case study
  - a brief literature review that provides context for the case study
  - a learning tutorial that describes the procedures and code involved in cleaning and analyzing the data, saved in a reproducible format (e.g., Jupyter notebook or Markdown document)
  - a summary of results in relation to the research questions
  - a data dictionary
  - rich metadata
- The initial team meeting is also an ideal time to identify training needs and discuss each sous-chef's specific cuisine of interest (e.g., education, economics, health), which will define the focus of the sous-chef's case study.
- In the initial meeting, chefs and sous-chefs can begin to explore possibilities for showcasing the buffet, such as through presentation or publication venues.

COOKING METHOD

- Each chef/sous-chef pair schedules an initial meeting to confirm the area of interest, formulate one to two research questions, and identify a suitable dataset or datasets to answer the research questions.

- Each sous-chef works independently, in consultation with their chef mentor, to accomplish the following tasks:
  - Refine the research questions.
  - Conduct a brief literature review.
  - Create a data pipeline for answering the questions, using the selected open dataset(s).
  - Conduct the analysis.
  - Summarize the results in the form of a case study.
- Chef/sous-chef pairs meet regularly throughout the project to discuss any challenges and to ensure that sous-chefs are making progress on their case studies.
- Meet regularly with the entire cooking team to share progress and learn from each other.
- During cooking team meetings, discuss possible repository options for the datasets and case study materials, considering the following questions:
  - Does the repository have a search feature that aids in findability?
  - What fees (if any) are associated with deposit?
  - What limits exist on individual and total file size?
  - What other requirements are involved in the deposit, and does the collection meet these requirements?
- Each sous-chef presents their case study to the cooking team for feedback and clarification.
- Upon finalizing the case study materials, each sous-chef submits the clean dataset in a standardized format (e.g., csv file), case study materials (e.g., Jupyter notebook or R Markdown document), data dictionary, and metadata to the executive chef for collating and review.
- Before submitting to the chosen repository, the executive chef reviews all materials for clarity, consistency, and completeness and creates a list of ingredients (README file) that summarizes the project and includes:
  - title of collection
  - author information
  - abstract
  - date of project
  - geographic location of project
  - funding source (if applicable)
  - licenses/restrictions
  - links to publications that cite the data (if applicable)
  - source(s) of data

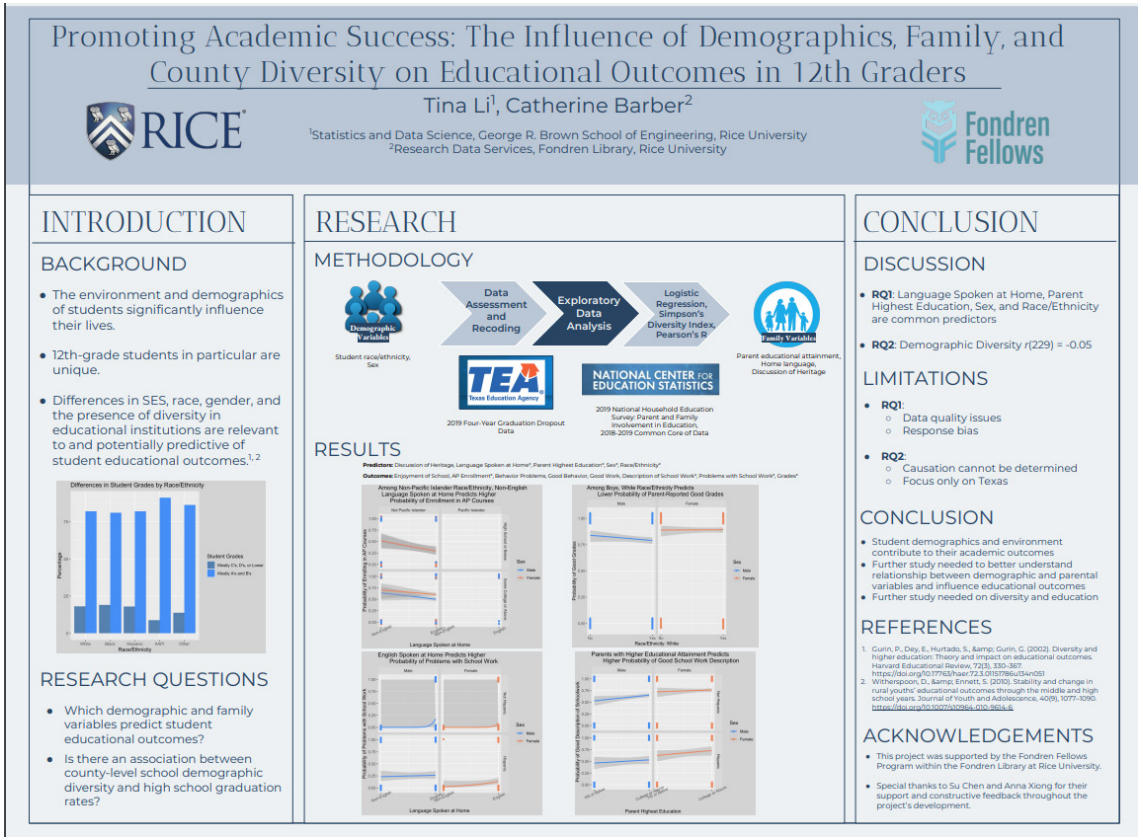

Figure 1. Promoting academic success: The influence of demographics, family, and county diversity on educational outcomes in 12th graders (Li & Barber, 2023).

  - annotated file list
  - version information
- Consider providing condiments to enhance the data files and case study materials. Suggested condiments include data-specific information such as code books, software syntax and output files, specialized data formats, and lists of abbreviations used in the materials.
- Once the buffet is prepared, invite taste testers to sample the materials and provide feedback. Key taste testers may include instructors from relevant departments (e.g., faculty in the social sciences who teach with government and educational data), colleagues at other university libraries who provide data-related instruction, and student researchers who may use the materials to learn about data science and/or conduct their own research.
- To facilitate broader interest in the buffet, request a digital object identifier (DOI) from the repository that will house the materials, and include this DOI in your communications (e.g., social media posts, LinkedIn profile, and email signature line) with future diners.

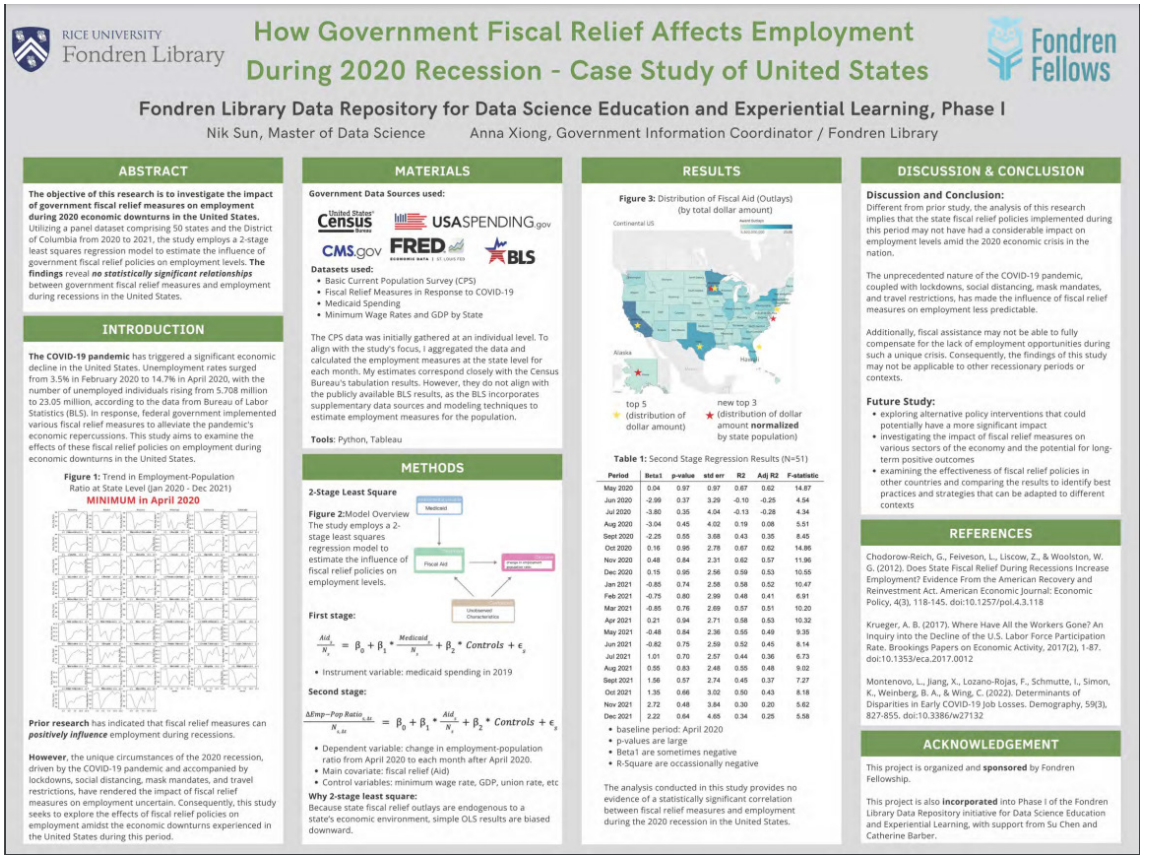

Figure 2. How government fiscal relief affects employment during 2020 recession—Case study of United States (Sun & Xiong, 2023).

CHEF'S NOTES

See figures 1 and 2 for examples of dishes presented by sous-chefs during a data showcase. For a successful buffet, heed the following advice:

- Too many cooks spoil the broth. Avoid the temptation to make the cooking team too large, as a very large team will pose logistical challenges. Regardless of team size, establish a schedule early in the semester, and stick to it. Provide clear expectations for attendance.
- Don't crowd the kitchen, but in order to avoid chef burnout, do ensure that the cooking team includes enough chefs to mentor sous-chefs.
- Variety is the spice of life. A successful buffet involves diverse datasets and case studies to appeal to learners of varying tastes and levels of experience. Include a range of topics and ensure that the buffet includes at least one case study and dataset for data science novices.
- Avoid pie in the sky. Choose the difficulty level of the dishes based on the sous-chefs' knowledge, experience, and skills. This will ensure that sous-chefs do

not become overwhelmed or spend too much time dealing with barriers caused by unfamiliar ingredients and/or cooking tools. Matching sous-chef to dish will facilitate smooth cooking and timely meals.

- Take care not to put too much on your plate. For sous-chefs to grow in their skills, they need mentor chefs who have sufficient expertise in data science. If some chefs are less experienced in data analysis and visualization, it will be important to find guest chefs who have these skills and who can provide training to the cooking team. This prevents chefs from having to learn in-depth data science skills while simultaneously teaching these skills to their sous-chefs. Training also ensures a consistent cooking style and excellent favor.

This project was funded by the Fondren Fellowship (https://library.rice.edu/places/fondren-fellows) at Rice University in Houston.

ADDITIONAL RESOURCES

We recommend the following websites as sources for open government datasets:

- Bureau of Economic Analysis, US Department of Commerce, https://www.bea.gov
- Centers for Medicare and Medicaid Services, https://www.cms.gov/newsroom/data
- Federal Reserve Bank of St. Louis Economic Research, https://fred.stlouisfed.org
- National Center for Education Statistics, https://nces.ed.gov
- US Census Bureau, https://www.census.gov
- USA Spending, https://www.usaspending.gov

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Arts x Eship x Copyright:

Teaching Arts Entrepreneurs About Copyright

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NUTRITION INFORMATION

This recipe will teach instructors how to facilitate workshops centered around the topics of copyright, fair use, and what constitutes "open" or remixable sources within an arts entrepreneurship context. The Arts x EShip: Copyright and Arts Entrepreneurship workshop was first taught in the spring of 2023 through the Arts x EShip workshop series at Carnegie Mellon University (CMU). The series sought to teach students in the arts and humanities—who might not have tech or business courses in their plans of study—the basics of copyright in the arts. These basics include the fundamentals of how to protect themselves and their art online, as well as how to make their work open, how to identify works that are remixable, and how to navigate the subtleties of fan art, commission requests, and more.

Most current students grew up in an online landscape where sharing and remixing is the norm. Teaching copyright prepares art students to be ethical and safe participants in online art communities and in the wider art market. With the advent of generative AI resources like Midjourney, DALL-E, and BeatOven, students also need help navigating topics of fair use and artistic inspiration.

This workshop empowers students to better understand the subtleties of their agreements and to know how and when they can take action if their agreements have been violated. The workshop's attention to ethical remixing and reimagining existing works also helps participants become more responsible community members.

LEARNING OUTCOMES

Cooks reading this recipe will learn:

1. how to facilitate a successful workshop discussing copyright, open access/open science, and community within the context of arts entrepreneurship;
2. how to empower students to define their own copyrights (or open agreements) and how to encourage ethical remixing of existing artworks; and
3. how such workshops fit within both the scope of the open science and social entrepreneurship landscapes on their campuses and beyond.

NUMBER SERVED

Given its virtual nature and flexible design, this workshop can serve as many as you are willing to accommodate.

COOKING TIME

Cooking time for the actual workshop is one hour, with a prep time of approximately three to four hours for brainstorming, lesson planning, and image sourcing, etc.

DIETARY GUIDELINES

This workshop is part of a healthy community of practice for artists, as well as for academics and community members who use art in their respective fields. Workshops like this not only show the reach of open science beyond traditional academic fields but also show how making parts (or the entirety) of one's own work open can contribute to social entrepreneurship ideals. By both knowing how to make one's own work available as well as knowing how to ethically use and attribute the work of others, students can create healthier resource sharing communities. Although the arts aren't as actively trapped behind paywalls as other academic works, making one's own work open (or knowing why they might choose not to) empowers our student, staff, and faculty makers to actively think about what kind of community they are trying to create as artists and how they and their work fits into (and works for) these communities.

INGREDIENTS AND EQUIPMENT

- a virtual meeting space (e.g., Zoom or Google Meet) if facilitating the workshop online or a physical meeting space with audiovisual capabilities that accommodates the number of learners you expect to attend
- a library website and registration form that can accommodate virtual registration in order to anticipate the number of attendees, facilitate workshop communications, and collect demographic information, which can be used to help plan future outreach/workshops
- marketing channels to distribute information about the workshop, including listservs of departments affiliated with the arts, individual faculty members working on related subjects, art-related student clubs (e.g., anime clubs, maker groups, etc.), social media, and physical flyers
- instructional tools of your choice, including Google Slides, handouts, a whiteboard, and/or LibGuides
- at least two hosts (for virtual iterations of the workshop) so one participant can share their screen while another monitors the chat
- an audience response tool like MiroBoard or Poll Everywhere

PREPARATION

Talk to departments through library liaisons, look at course schedules in your departments, and consult statistics from previous workshops to determine preferred days, times, and modalities for potential workshop attendees. Keep in mind that if you offer the workshop virtually, you can always record it for people who can't attend in person or modify to offer the workshop as an asynchronous module. (Note: this workshop is a great fit for themed weeks like Fair Use/Fair Dealing Week (https://www.fairuseweek.org/) and Love Data Week.) Once you've selected a date, time, and modality, post the workshop and start marketing.

To create a successful lesson plan for the workshop, you'll want to start by reading up on copyright, fair use, and how they relate to art. Some of our favorite quick reference sources are "What is Copyright?" (https://www.copyright.gov/what-is-copyright/) and Stanford Libraries' Measuring Fair Use: The Four Factors (https://fairuse.stanford.edu/overview/fair-use/four-factors/), but there are many great resources that explain these concepts and how they relate to artistic disciplines.

Next, outline the main points you want to cover in the workshop, considering how they relate to your artistic community of library users. Feel free to alter the lesson plan below to fit your community's tastes, whether that means including more discussion, altering topics, or switching up instructional methods.

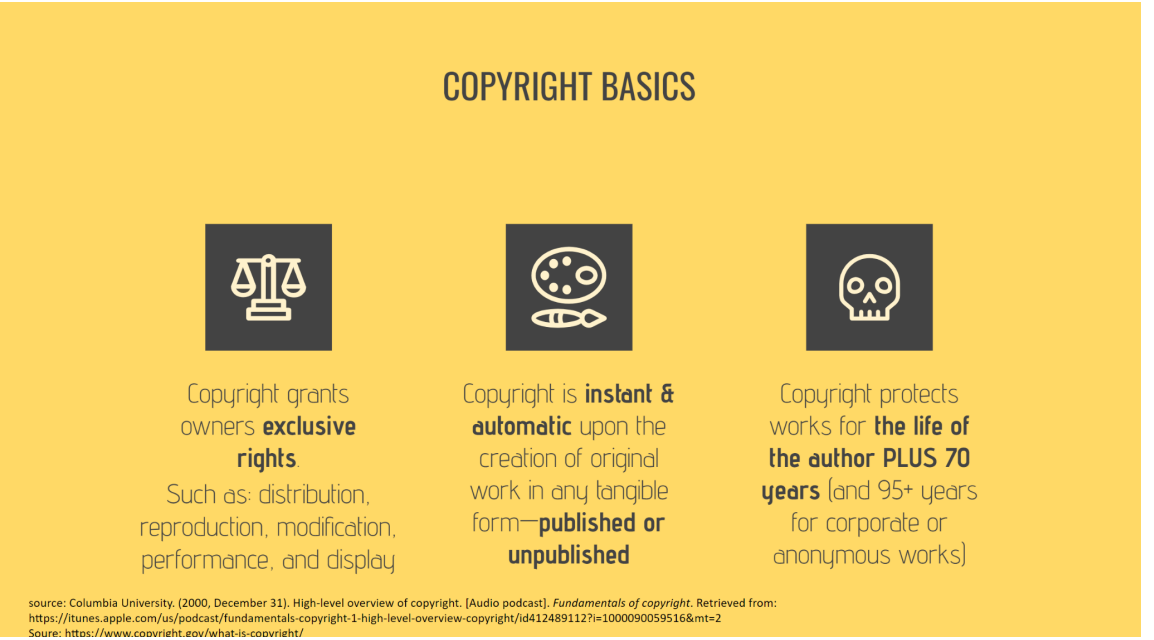

Figure 1. Copyright basics.

COOKING METHOD

At its core, this lesson plan foregrounds the importance of being an ethical member of the artistic community and empowers student by informing them about types of copyright, the tenants of fair use, and their rights as artists.

Section 1: A Brief Introduction to Copyright Concepts

1. audience poll: "What do you want to learn from today's workshop?"
   This poll can be answered through a variety of participatory tools where participants can log their answers anonymously. Although anonymity is not entirely necessary, it does sometimes help to encourage people to participate.
2. copyright basics (see figure 1): The US Copyright Office is a good resource (https://www.copyright.gov/what-is-copyright/).
3. public domain: A quick introduction to give participants an idea of when and how works enter the public domain.
4. the four factors of fair use: (1) purpose and character, (2) nature of the work, (3) amount and sustainability, and (4) effect of use. Stanford Libraries' Measuring Fair Use: The Four Factors (https://fairuse.stanford.edu/overview/fair-use/four-factors/) is a great resource.

Section 2: Rights as an Artist

In this section, students will learn about:

1. their rights are as an artist (see figure 2);
2. what kinds of creative commons licenses are available, should they choose to make their work open to different forms of use;
1. definitions of some trickier copyright concepts (e.g., trademarks versus patents versus copyright);
2. how to protect their art (and their copyright during commissions), for example: (1) taking money up front (or in an installment plan), (2) having a written agreement about what the piece entails, who owns the copyright of the piece, etc., and (3) giving heavily watermarked or low resolution previews so work can't be stolen; and
3. copyright and fair use as it relates to fanart.

Section 3: Art Theft

1. types of art theft: typically art theft can be divided into two categories– posting or selling work without attribution/permission or copying style or composition in an attempt to pass work off as another artist's. It helps to provide examples so students can see what constitutes art theft and the different platforms it can occur on.
2. how to tell if your art has been stolen: Encourage your learners to reverse Google search their images as a general practice.
3. how can artists prevent art theft: uploading lower quality images, watermarking images, making paywall enhanced content for access to art, etc.

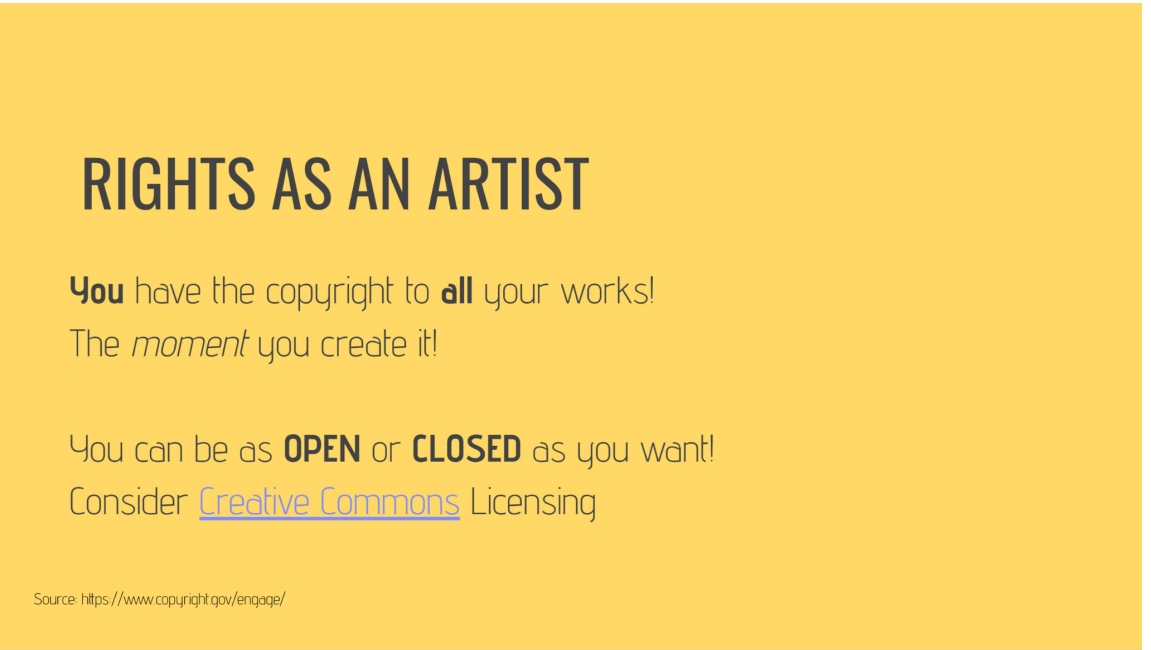

Figure 2. Rights as an artist.

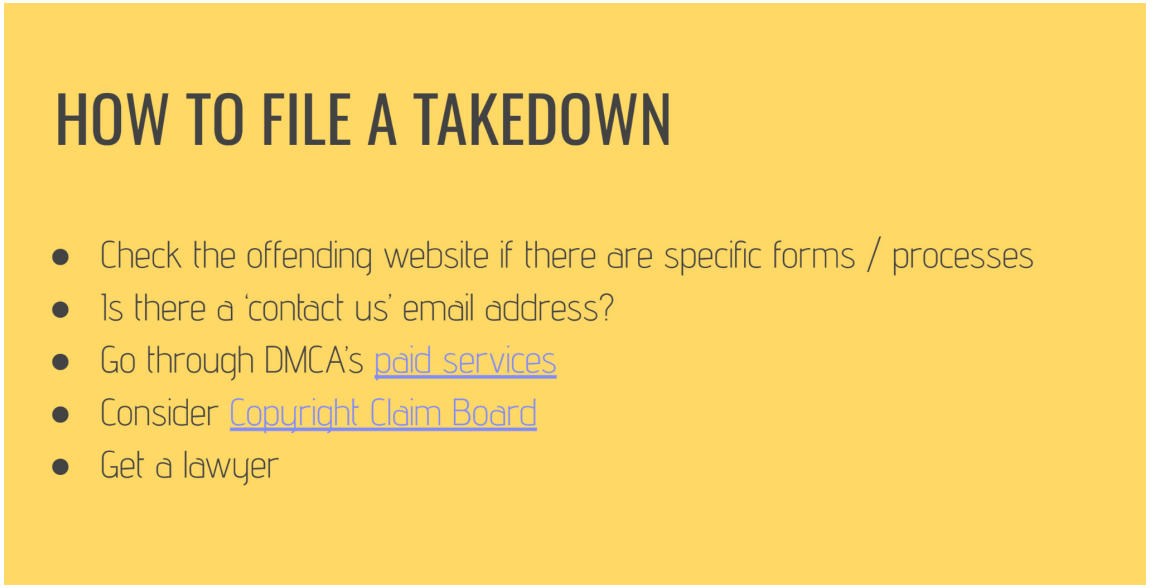

Figure 3. How to file a takedown.

Figure 4. Being an ethical member of the community.

4. guidance on what to do if their art gets stolen: How to file takedowns (see figure 3), request attribution or payment, etc. Also invite students to consider the potential benefits and risks of posting their art online.

Section 4: How Not to Infringe Copyright
This is a great time to show examples, like Andy Warhol's use of pop culture images, foster discussion, and remind workshop attendees that they should be ethical members of the art community. (See figure 4.) Include information about attributing reposted content, elevating other creators, using AI ethically, and buying directly from artists rather than from big companies who might be stealing works from small artists.

CHEF'S NOTES

This lesson must consider the ethical uses of generative AI in the arts as a core part of the workshop and should be adapted as laws change and new technologies emerge. Possible topics include:

- how to use AI ethically as an artist (e.g., brainstorming using Midjourney rather than using it to create a final product, using AI assisted tools in photoshop to complete a background, etc.), and
- how to protect your work from AI technologies using tools such as Glaze and Nightshade.

Keep in mind that you do not need to be a copyright lawyer to plan and facilitate this workshop. Do not attempt to answer tricky

legal questions or give legal advice, but do plan to make resources and information available via slides, handouts, and/or LibGuides for students to consult after the workshop.

REFERENCES

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Creative, Venn, & Venn. (2018, April 5.) *A guide to copyright infringement*. The Illustrators Guide. https://theillustratorsguide.com/copyright-infringement/.

Columbia University Libraries. (n.d.) *Fair use*. Retrieved February 8, 2023, from https://copyright.columbia.edu/basics/fair-use.html.

Stanford University. (n.d.) *Measuring fair use: The four factors*. Retrieved February 7, 2023, from https://fairuse.stanford.edu/overview/fair-use/four-factors/

US Copyright Office. (n.d.) *Engage your creativity*. Retrieved February 7, 2023, from https://www.copyright.gov/engage/

US Copyright Office. (n.d.) *What is copyright?* Retrieved February 7, 2023, from https://www.copyright.gov/what-is-copyright/

US Patent and Trademark Office. (n.d.) *Trademark, patent, or copyright*. Retrieved February 7, 2023, from https://www.uspto.gov/trademarks/basics/trademark-patent-copyright

Zimmatore, B. (2020, December 3.) How to file a DMCA takedown and protect your reputation. *Entrepreneur*. https://www.entrepreneur.com/leadership/how-to-file-a-dmca-takedown-and-protect-your-reputation/359772.

PRESENTATION INFORMATION

Presentation template by Slidesgo

Icons by Flaticon

Images & infographics by Freepik

Author introduction slide photo created by Freepik

Text & Image slide photo created by Freepik.com

Big image slide photo created by Freepik.com

Section 3.

Outreach

Engaging Small Group Open Access Education for STEM Students and Faculty

***Michelle E. Wilson**, Head, Open Scholarship Services, University of Maryland, College Park and **Sarah Weiss**, STEM and Open Science Librarian, University of Maryland, College Park*

NUTRITION INFORMATION

Open access (OA)—information made available online free of any fees or other access barriers—is a principal component of open science practices, which promote transparency, reproducibility, and collaboration at all stages of the research lifecycle. Open access not only provides equitable access to research to a global audience, it also benefits researchers by offering increased visibility and potential for citation, and OA publishing is increasingly becoming a requirement of funding organizations worldwide.

In spite of all this, engaging STEM departments with OA resources at the library can present a challenge. Frequently, faculty and student knowledge around OA is limited, and there are persistent misconceptions that conflate OA journals with predatory publishing practices or a lack of rigor in peer review. In addition, faculty and graduate students often have no interest in attending a large workshop or lecture geared towards a general STEM audience because they fear or assume that the specific concerns of their discipline or department will not be addressed.

Designed with STEM and scholarly communications librarians in mind, this recipe empowers the reader to deliver targeted OA education in small-group environments like department meetings, graduate affinity groups, and classrooms. In addition, this recipe enables librarians to more deeply engage these community groups in discussions about open science library resources by encouraging them to get to know their constituents and customize educational materials.

LEARNING OUTCOMES

This recipe enables librarians to conduct OA education that will teach participants to:

- define the main OA publishing models—Green, Gold, and Diamond;
- articulate the benefits of publishing OA;
- assess the quality and legitimacy of OA journals; and
- make informed decisions about how to publish openly in the way that best aligns with their specific research goals.

NUMBER SERVED

This recipe is designed for faculty and graduate students and best serves groups of two to thirty participants. A smaller group size leaves ample time for discussion, but the content can be scaled to larger groups.

COOKING TIME

Prep time can vary depending on the needs of the target audience, and presentations can range from thirty to ninety minutes.

DIETARY GUIDELINES

The targeted instruction in this recipe will help improve general open access literacy, promote related library services, and encourage open publishing practice. In addition to education, many academic libraries directly support open access publishing and initiatives for their patrons. Outreach through OA education helps to increase use of these services.

INGREDIENTS AND EQUIPMENT

- librarians—at least one of the following, and even better in collaboration:
  - subject specialist/liaison librarian
  - open scholarship/scholarly communications/publishing librarian
- cohort contact who will act as the primary source of communication
- list of OA services/tools offered through the library and across the wider campus (e.g., institutional repository, OA policies, transformative agreements, publishing funds and grants, on-campus publishing and hosting services)

- list of resources to help participants find and evaluate OA publishing outlets (e.g., Directory of Open Access Journals, OA repository lists, etc.)
- space that will accommodate all participants (e.g.,
  - department or library office, conference room, or classroom space; remote meeting room, etc.)
- presentation slides and/or handouts (See Additional Resources below for examples.)

PREPARATION

Event promotion (see figure 1):


DEPARTMENT OF
CIVIL & ENVIRONMENTAL
ENGINEERING

Diversity, Equity & Inclusion Committee Presents:

An engaging workshop ~

Open Access Publishing, Funding & DEI

Wed., Nov. 2, 2022 ~ 12:00 - 1:00

Martin Hall/CEE Conference Room #1179

~ Or attend virtually via Zoom ~

Sarah Weiss
Engineering Librarian

Michelle Wilson
Open Scholarship Librarian

Abstract:
Recently, the White House administration mandated that the results of federally funded research be made freely available, without embargo by the end of 2025. This has boosted the discussion around open access in the research community. But what exactly is open access and why is it seen as controversial? What do funding agencies want? How do issues around open access impact DEI at this university and beyond? Join us for an introduction to open access and some of the important issues surrounding it.

Figure 1. Fliers can be an effective method of promoting the workshop.

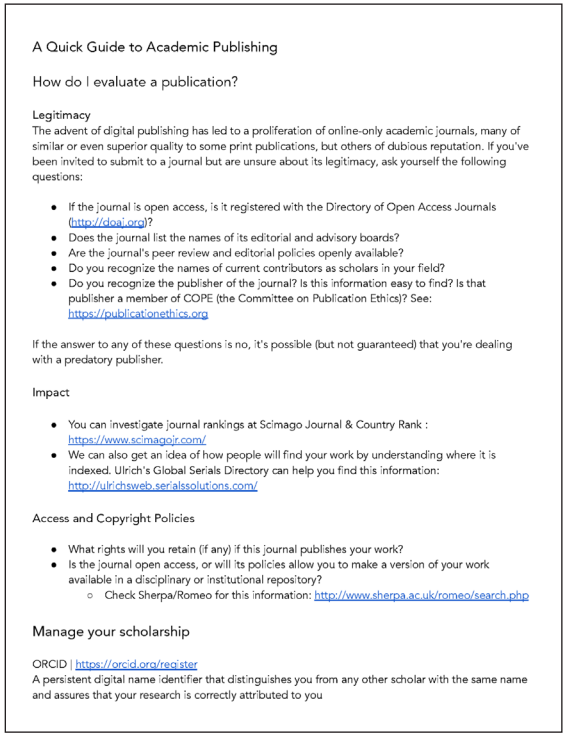
- Arrange to market the event with the department or group contact person. A member or leader of the cohort to which you are speaking will provide the most efficient way to advertise your event (and possibly require attendance).
- Sending emails, creating fliers, or promoting online can all be effective, but the strategy needs to be tailored to the group. Since this is a cohort-specific event, general promotion avenues within the libraries may not be appropriate or effective.
- Work with the contact person to create promotional materials. The librarian can create the materials, but the contact should, at minimum, review them.

Choose a location and time:

- When choosing a location, consider how to engage the most participants.
  - Faculty members may prefer a departmental conference room or office.
  - A room in the library may best serve graduate students.
  - Virtual meetings can make the presentation more accessible, but dialogue can be more challenging.
- If possible, consider fitting your presentation into an existing gathering, such as a department meeting, to increase attendance and meet your audience where they are.
- The space will need to have access to a screen for displaying the presentation.

Prepare the presentation:

- Tailor presentation slides/handouts for the specific audience (see figures 2 and 3) by:
  - meeting with the contact person to ask about the group's familiarity with open access, major concerns, and points of confusion or curiosity and
  - researching OA publication examples specific to your group (try to find examples where faculty have already published, but this can also be good opportunity to highlight new sources as well).


A Quick Guide to Academic Publishing

How do I evaluate a publication?

Legitimacy
The advent of digital publishing has led to a proliferation of online-only academic journals, many of similar or even superior quality to some print publications, but others of dubious reputation. If you've been invited to submit to a journal but are unsure about its legitimacy, ask yourself the following questions:

- If the journal is open access, is it registered with the Directory of Open Access Journals (http://doaj.org)?
- Does the journal list the names of its editorial and advisory boards?
- Are the journal's peer review and editorial policies openly available?
- Do you recognize the names of current contributors as scholars in your field?
- Do you recognize the publisher of the journal? Is this information easy to find? Is that publisher a member of COPE (the Committee on Publication Ethics)? See: https://publicationethics.org

If the answer to any of these questions is no, it's possible (but not guaranteed) that you're dealing with a predatory publisher.

Impact

- You can investigate journal rankings at Scimago Journal & Country Rank : https://www.scimagojr.com/
- We can also get an idea of how people will find your work by understanding where it is indexed. Ulrich's Global Serials Directory can help you find this information: http://ulrichsweb.serialssolutions.com/

Access and Copyright Policies

- What rights will you retain (if any) if this journal publishes your work?
- Is the journal open access, or will its policies allow you to make a version of your work available in a disciplinary or institutional repository?
  - Check Sherpa/Romeo for this information: http://www.sherpa.ac.uk/romeo/search.php

Manage your scholarship

ORCID | https://orcid.org/register
A persistent digital name identifier that distinguishes you from any other scholar with the same name and assures that your research is correctly attributed to you

Figure 2. Handouts can go into further detail on a specific topic or serve as a learning aid to reinforce the content of the presentation.

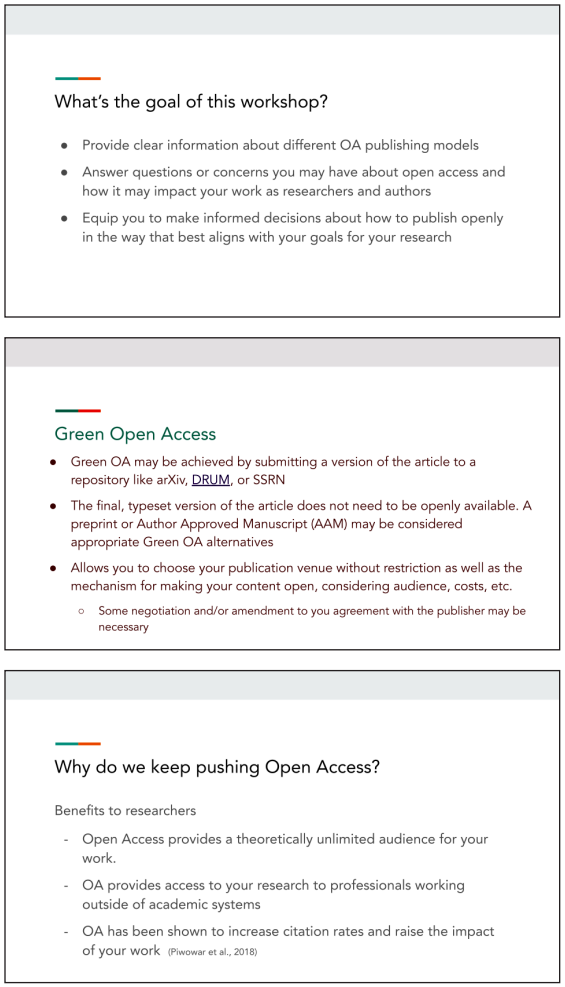


Figure 3. Sample slides from a workshop conducted at the University of Maryland, College Park, MD

- Have handouts available, if appropriate (see Additional Resources for example materials).

COOKING METHOD

Use the following as a guide for your open access session. These steps are presented in a suggested order, but they can be modified as needed to most effectively serve the target audience or accommodate time constraints.

1. Start with a welcome and overview of the topics that will be covered.
2. Provide a neutral definition of open access and define the three major OA models (Green, Gold, and Diamond).
3. Discuss the benefits of OA, including knowledge equity and benefits to researchers. With an increase in mandates surrounding open access and years of misconception and/or confusion, many researchers need to hear about the benefits of OA. Start the conversation off on a positive note!
4. Address key OA concerns. The OA landscape is dynamic and frequently changing, which can be confusing to researchers. OA models are not immune to inequity, and the shift from traditional subscription models threatens long-established publications and scholarly societies. Acknowledge the legitimacy of these concerns and provide space for conversation. This section can be tailored to your audience's key areas of anxiety based on the information gathered during preparation.
5. Discuss how participants can engage in open access. Provide demonstrations or information about discovering open access publishing venues, evaluating journals for quality and impact, and avoiding predatory journals. Highlight on-campus resources that support OA publication, like funds supporting APCs (author processing charges), local grants, and read and publish agreements. This can also be a moment to talk about OA mandates, such as institutional open access policies or funder requirements.
6. Review how the library can support the group with OA. Remind them they can work with a librarian to evaluate or select a journal and discuss funder requirements, publisher agreements, and other open publishing options (e.g., repositories). This is also an opportunity to remind participants about any relevant library services and resources that have not yet come up.
7. Leave plenty of time for questions and discussion.
8. Wrap up the presentation and thank everyone for their participation.
9. Send follow-up emails to participants or department contacts with resources, answers to questions, or anything else that comes up during the presentation.
10. If appropriate, organize a follow-up session to take a deeper dive into an area of interest or confusion.

CHEF'S NOTES

- In our experience, faculty are almost always receptive to being presented with well-organized information, and the small-group dialogues are valuable for both the participants and librarians.
- Avoid making assumptions about a group's prior knowledge and attitude.

We have noticed stark differences even between departments in the same discipline.

- For smaller institutions without publishing librarians or departments, or for libraries that may not currently have many OA services or tools, promote non-institutional repositories (see Additional Resources for suggestions).
- If you are short on time, you can still prepare an effective presentation. The supplemental materials referenced in the Additional Resources section are published under a CC0 license and can be used and modified without restriction.

ADDITIONAL RESOURCES

Wilson, M. (2024). A quick guide to academic publishing. Digital Repository at the University of Maryland. https://doi.org/10.13016/pr4b-rvif

Wilson, M. (2024). Author contract checklist. Digital Repository at the University of Maryland. http://hdl.handle.net/1903/32400

Wilson, M. (2024). Open access presentation template slides. Digital Repository at the University of Maryland. https://doi.org/10.13016/4ym3-i6cf

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Wilson, M. (202) Handout: Academic Journals—evaluation, selection, and author rights. Columbia University Libraries Academic Commons. https://doi.org/10.7916/d8-rn52-xe88

University of Maryland Libraries. (n.d.) *Repository services.* Retrieved [2-12-2-24] from, https://www.lib.umd.edu/research/oss/publishing-and-digital-projects/repository-services

When Plating Matters:

Delivering Data Literacy Through Graphical Handouts

***Renata Goncalves Curty**, Research Facilitator, Social Sciences, University of California, Santa Barbara (UCSB) Library, Research Data Services; **Greg Janée**, Department Director, University of California, Santa Barbara (UCSB) Library, Research Data Services; and **Julien Brun**, Research Facilitator, Earth and Environmental Sciences, University of California, Santa Barbara (UCSB) Library, Research Data Services*

NUTRITION INFORMATION

In today's data-driven landscape, academic and research libraries are crucial in providing data management instruction and increasing researchers' data literacy. While traditional instructional methods such as drop-in sessions, consultations, and workshops can effectively engage scholars in open science principles and data management best practices, libraries with limited resources need to find innovative ways to effectively scale their communication to a campus-wide audience and increase their impact on campus research activities. One approach is using graphical handouts as an auxiliary tool to summarize complex content and cover essential concepts, tools, and techniques.

Infographic handouts can complement data instruction and help librarians promote data literacy in the broader campus community in several ways. First, they can make complex information more accessible. Second, they serve as entry points for deeper engagement on complex topics, sparking conversations and follow-up interactions with researchers and students. Third, they can be easily integrated both digitally and physically into existing library activities and programs and can help promote library engagement across the board.

LEARNING OUTCOMES

By reading this recipe, the cook should be able to:

- develop graphical one-pagers and integrate them into existing library programming and services to promote data literacy and
- formulate a strategic and sustainable plan to launch a handout-based data literacy program, including defining objectives and selecting appropriate themes and distribution channels.

NUMBER SERVED

This is a versatile recipe that can be seamlessly integrated into the library's service menu. It can also be savored as a standalone option. Its scalability, accommodating gatherings of all sizes based on the chosen distribution method, enhances its appeal.

This recipe caters to diverse preferences, from small groups to the campus community at large, from undergraduates to senior researchers, and can be customized to better appeal to the target audiences. For best results, we recommend that libraries consider adding this recipe to their monthly menu of services.

COOKING TIME

It should take about a month to formally launch a graphical handout series, but once the series is up and running, you will be able to create handouts more efficiently. After you have chosen a theme, outlined the expected learning outcomes, and identified the core content for your handout, the production process can take anywhere from two to three days, depending on the complexity of the graphical elements you intend to include.

Additional time is necessary if you plan to create supplementary materials like LibGuides, templates, videos, or podcasts, or if you want to incorporate interactive elements such as forms, quizzes, or polls for added engagement. Also plan to allocate extra time if you intend to gather and incorporate feedback from "tasters" before you publish/distribute the handouts.

DIETARY GUIDELINES

This recipe is designed to render data literacy content in a more enticing and digestible

format for the campus community. This approach offers a time-efficient, portable, and adaptable means to integrate data literacy into existing programming.

These handouts can cover an array data-related topics, including file naming conventions, version control, metadata standards, and data visualization, and reinforce the practice and principles of open science. Handout topics can be selected based on consultations with researchers and subject liaisons and/or designed around events, collaborative projects, emerging services, or instructional needs.

INGREDIENTS AND EQUIPMENT

You will need the following components to assemble a graphical handout similar to the one presented in figure 1:

- personnel: Include at least one data librarian or specialist with some graphic design skills to lead the kitchen; if you have a larger group of skilled chefs to join the *brigade de cuisine,* even better. In that case, make sure to assign responsibilities and set expectations. If your library has a dedicated marketing and communication team, invite them as creative sous-chefs to taste your samples and help you perfect the recipe along the way.
- visual identity: Craft cohesive branding elements (i.e., logos, color schemes, and typography) that harmonize with your existing library branding. Explore partnerships with marketing and communication teams for better results. Consider offering color contrast accessible options and print-friendly versions.
- partnerships: Welcome subject liaisons and other library staff to join your kitchen and assist you as specialized guest chefs to diversify your menu and infuse fresh perspectives and new flavors into your offerings.
- graphic design software (e.g., Canva, Kittl): Create visually appealing, engaging handouts with a short learning curve. Premium versions offer a broader collection of stock imagery, templates, font types, and effects. Create a workspace/folder dedicated to your handout series. If using a shared subscription, ensure you have clear policies around authorized access and permissions and that you safeguard additional copies of your handouts.
- ancillary tools (e.g., a short URL system, a QR code generator, file compressors, video and audio editors): to support the creation of supplemental and interactive objects to embed in the handouts. We advise you to stay consistent with the tools adopted by other departments.
- email marketing distribution service (e.g., Constant Contact, MailChimp): These services personalize email greetings, organize your mailing list, manage subscriptions, and collect valuable impact metrics. Some allow you to collect strategic data like successful deliveries, clicks, open rates, subscriber base growth, etc. (See figure 2.)
- storage, preservation, and long-term access system: Decide where the series and its issues will be hosted and establish an archiving and preservation strategy to ensure handouts are accessible and easy to retrieve via a website or repository. Adopt a file naming convention, and enhance searchability by applying informative tags and mint persistent identifiers or permanent links for each issue. Apply similar importance to digital objects you embed into the handouts to ensure they will remain accessible.

Figure 1. Sample handout uses a metaphor to organize content. The handout includes (1) branding elements for visual identity, (2) series and issue numbering, (3) catchy title, (4) main concept description and tips in bullet points, (5) learning objective, (6) embedded resource, and (7) contact information/help.

- licensing: Graphical handouts are considered creative work. Be sure to explicitly designate a Creative Commons license so others can correctly attribute, remix, and reuse them.
- creativity: Every good recipe has a secret ingredient that gives it that special touch. Infuse handouts with a dash of innovation and artistic flair, making them informative and visually delightful. Enhance the diversity of your handouts by incorporating a variety of graphical and textual elements. Use metaphors, anecdotes, and context-based scenarios when possible to make content more relatable and engaging. Consider including supplementary materials and interactive components (e.g., quizzes, polls) to further enrich the learning experience.

Figure 2. Email campaign example; recipients can open the PDF or interact with the flyers and any links directly in the email.

PREPARATION

Follow these steps to create, share, and integrate your handouts into the library's programming:

Step 1: Resources and Planning

- Make a clear outline of the objectives for the graphical handout series. Determine your target audience and identify the data-related topics or concepts you wish to cover.
- Gather selected tools and personnel.
- Decide on your first topic. Maintain a list of potential topics as you progress. When you run out of ideas, seek insights from others on current hot topics and data literacy knowledge gaps. Collaborate with subject liaisons and faculty members to identify topics aligned with academic disciplines. Consider themed months, like a Halloween edition for Research Data Scares. Try to align your handouts with upcoming workshops and activities. For example, develop and plan to release a handout on how to choose a graph to coincide with a seminar on best practices in data visualization or create a handout on data cleaning to complement a workshop on OpenRefine.

Step 2: Content Creation

- Determine two or three learning objectives and key concepts for the handout. Identify relevant existing resources that can be embedded in the handout. Consider developing new digital objects to enhance the content. For example, a handout covering the importance of README files could link users to a customizable template. Always include your contact information and encourage engagement with your department.
- Use your graphic design software and data visualization tools to create a visually engaging handout. Test placement, balance colors, visuals, and text. Ask for feedback on style, readiness, and clarity as you progress. Be culturally sensitive with graphs and icon choices. Employ formatting tools (e.g., bullet points, headings, subheadings, text styles) to emphasize critical points, key takeaways, or recommended actions. Keep lists to no more than seven bullet points. Use charts, diagrams, or tables to condense data or illustrate concepts.

- Choose an attention-grabbing descriptive title for your graphical handout (e.g., How to Choose a Data Repository, Be FAIR to Your Data, and Why Should I Get an ORCID?)
- Once you have a more complete draft, get another round of feedback. Make sure to ask reviewers to test any links, QR codes, etc.
- Generate your final version in a user friendly, light, open, and portable format that holds URLs (e.g., PDFs).

Step 3: Distribution and Promotion

- Define a systematic workflow for creating, reviewing, and publishing the handouts. Assign responsibilities to team members and set expectations and deadlines.
- Decide on release frequency, whether monthly, quarterly, or another schedule. Identify the most effective channels for distributing your handouts, including library websites, social media platforms, email newsletters, and physical distribution within the library or department offices.
- Publish the handout online in a user-friendly manner, and include an option for the website's visitors to subscribe to the series. Apply informative tags for easy reference (see figure 3). The publication of the handout must precede the announcement and distribution of the issue since your communications will include a link to an online copy of the handout.

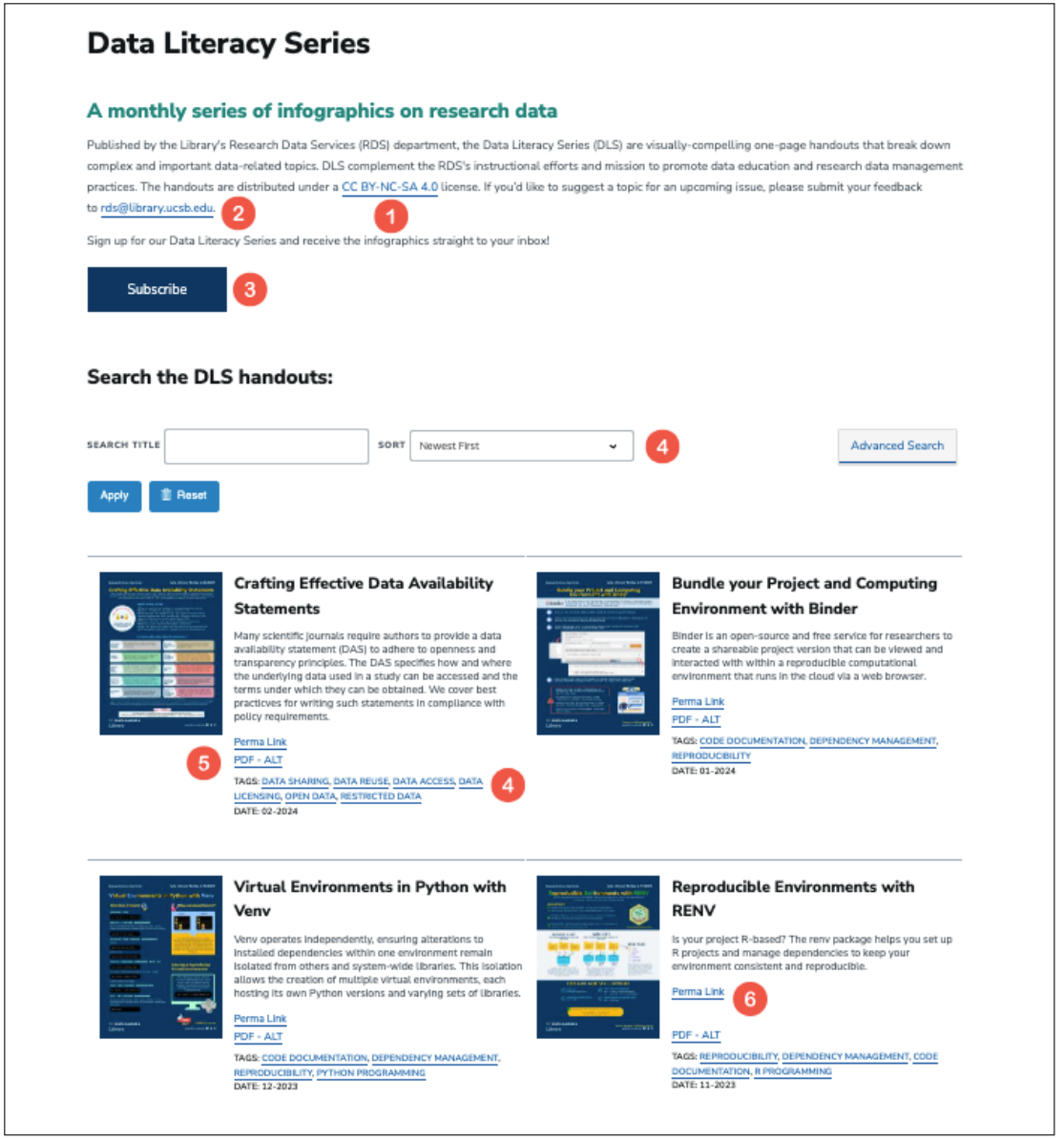

Figure 3. Web publishing example includes (1) description (goal, license information, etc.), (2) request for feedback and suggestions, (3) subscription option, (4) multiple ways to search and order the handouts (tags, free search, sorting), (5) an ALT version for contrast (PDF friendly format), and (6) persistent identification (permalink).

- Announce the new handout to email subscribers, and encourage them to provide feedback, spread the word about the series, and view previous handouts in the series (see figure 2).
- Share handouts through selected distribution channels. In digital form, promote them on the library's website, official social media platforms, and email newsletters to maximize visibility. Encourage subscriptions through these channels and word-of-mouth. Distribute hard copies at campus events, orientation seminars, consultations, workshops, and classrooms.
- Explore opportunities to integrate these handouts into existing library programming; collaborate with subject liaisons and other library departments.
- Seek feedback from library users and stakeholders to facilitate ongoing improvements. Adapt content and design based on user input. If you use an email distribution service with access metrics, use that data to inform your strategies. Regularly assess the impact of your flyers on data literacy within your library community and be open to making improvements.

CHEF'S NOTES

This recipe is flexible and can be adapted to accommodate various dietary restrictions (library-specific needs) and preferences (visual style and content). Ensure your approach aligns with your library's mission and goals.

Keep handouts uncluttered, clear, and understandable, in terms of visuals, content, and language. Avoid large blocks of text and unexplained technical jargon; sequence handouts to cover large topics in digestible portions. For example, to address a topic like metadata standards, you might begin with an overview handout and then follow up with handouts targeted at specific standards or disciplines (see figure 4). Ensure URLs, QR codes, or any links to external resources remain accessible as the series evolves.

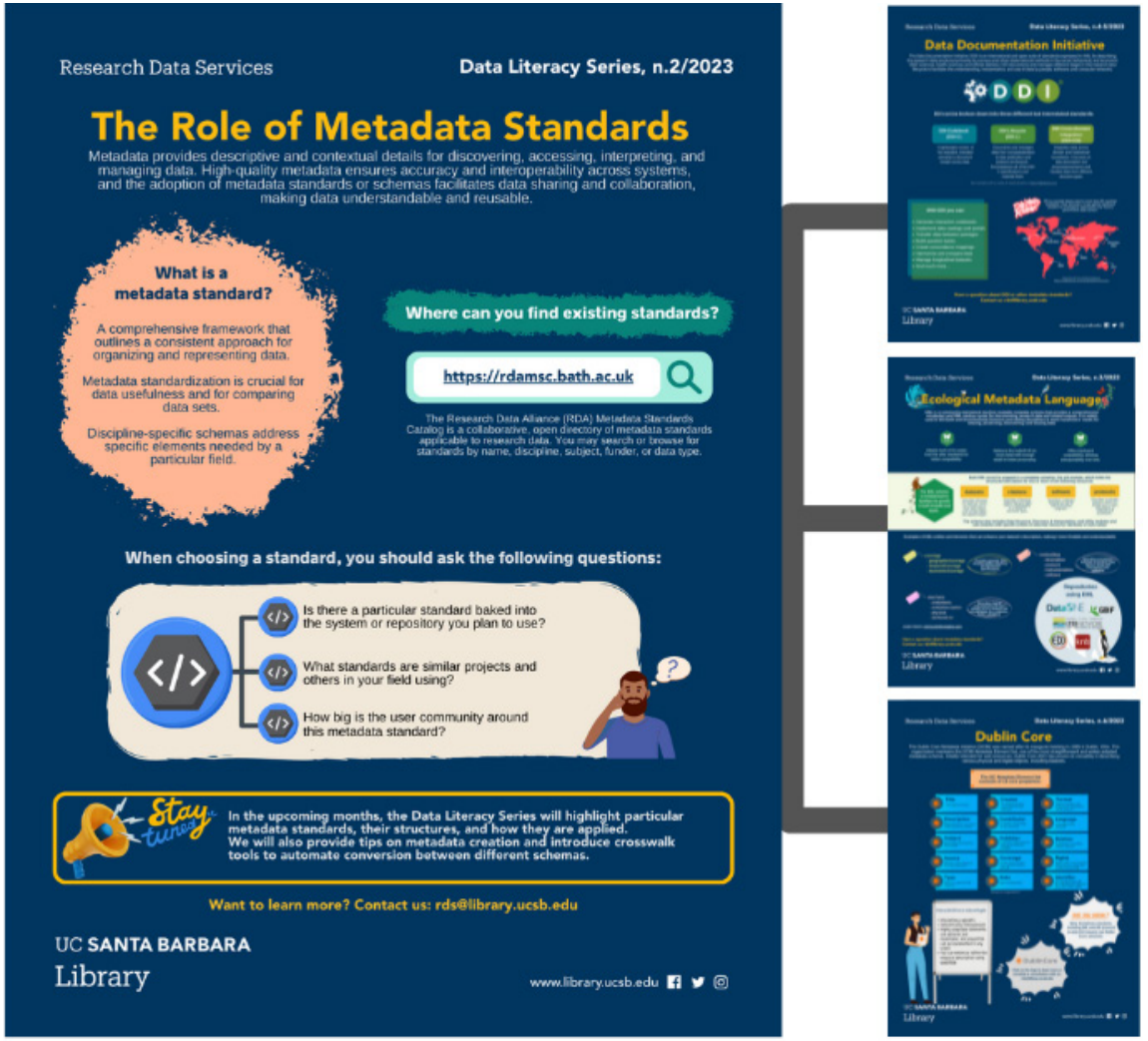

Figure 4. An introductory handout extends to interconnected handouts.

Finally, remember that collaboration and feedback from library staff and users are vital ingredients for success. Bon appétit!

ADDITIONAL RESOURCES

The Data Literacy Series (DLS) graphical handouts can be downloaded in PDF format from the University of California, Santa Barbara (UCSB) Research Computing Data website: https://rcd.ucsb.edu/data-literacy-series.

Creating a Feast to Embrace Open Data Mandates

***Katy Smith**, katy.smith@slu.edu, ORCID: 0000-0003-3195-3317*

NUTRITION INFORMATION

Proper data management and sharing is a necessary component of reproducible research and is increasingly required by federal funding agencies and publishers.

This recipe for a feast to embrace open data mandates will help libraries of all sizes (whether or not they have a dedicated data management librarian), encourage faculty and staff to embrace data planning and sharing, raise awareness of the importance of open data and research reproducibility, and present data management and sharing instruction particular to a specific mandate.

LEARNING OUTCOMES

Chefs following this recipe will be able to:

- recognize options for resources, tools, and content that can be used when designing a feast on data management and sharing mandates.
- develop and implement a customized feast including outreach materials and instruction session(s) for a data management and sharing mandate of your choice.

NUMBER SERVED

The recipe yield can vary based upon the preferences, dietary restrictions, and appetites of the guests.

COOKING TIME

From creation to final presentation, this recipe takes approximately three months to complete. Cooking times may vary depending on the menu and available kitchen equipment. Be sure to periodically check progress as cooking time may need to be adjusted.

DIETARY GUIDELINES

This recipe focuses on preparing research faculty, staff, and graduate students for the NIH Data Management and Sharing Policy, effective January 2023, and is modeled on an initial feast held at The Medical Center Library, Saint Louis University, for research faculty, staff, and students in Fall 2022. It can be adapted to address other data management topics and/or mandates.

INGREDIENTS AND EQUIPMENT

- familiarity with basic data management best practices
- a graphic design tool like Canva
- a content management platform like Springshare LibGuides
- a slide presentation software like Microsoft Powerpoint or Google Slides
- a web-based conferencing platform like Zoom
- DMPTool—a free, open-source application that helps researchers create data management plans
- patience
- creativity
- positivity
- a dash of humor

PREPARATION

Build the *brigade de cuisine*:

- Reach out to institutional stakeholders who bring unique knowledge and experience to the kitchen. Don't attempt to prepare the feast alone!
- Participate in external groups and/or conversations with other chefs who are working on similar projects or who have experience with data services.

Plan the feast:

- Determine what can reasonably be achieved given the limitations of the kitchen. This recipe provides for a three-course feast; chefs are encouraged to utilize culinary improvisation and to modify dishes to accommodate the dietary restrictions and preferences of their guests.
- Schedule the feast.
- Work with stakeholder chefs to prepare and distribute targeted appetizers—flyers, announcements, and invitations to the upcoming feast.

Practice *mise en place*:

- Collect supporting materials like research data management resources and best practices.
- Identify existing templates and other

tools, like the freely accessible DMPTool that provides templates for data management plans.
- Develop supporting materials as needed.
- Review and revise the feast plan as the courses develop and guests begin to RSVP.
- Start small; it is easier to add a course than to try to drop one that might be integral to the feast.
- Create and follow a timeline to ensure that courses will be served as scheduled.

COOKING METHOD

Appetizers

- The appetizers served at the initial feast included a platter of eye-catching print and digital flyers and a basic LibGuide.
- A flyer (see figure 1) addressed the specifically impacted audience, summarized the NIH DMSP into one statement, provided a QR code linking to a soon-to-be expanded LibGuide with links to data management resources and the official NIH DMSP website, and included local contacts for more information.
- The appetizer can be fully prepared and served while still developing the other courses. The initial appetizer LibGuide was later expanded and served as dessert.

Main Course

- Use the principles of backwards design (Wiggins & McTighe, 1998) to plan the main course—start with the desired instructional outcomes or objectives and include formative and summative assessment.
- The initial feast's "protein" was a slide deck created in Canva, exported to Microsoft PowerPoint, and presented synchronously to research faculty, staff, and students in a hybrid format. The presentation outlined the purpose and scope of the new NIH DMSP, as well as the policy's two basic requirements. Unfortunately, the initial main course was not exactly delectable. It relied too heavily on text and was, frankly, boring. For subsequent iterations of the main course, the chef used Canva to create a reimagined epicurean delight that effectively presented the policy in a straightforward visualization rather than through bureaucratic language (see figure 2).
- The initial feast's well-received seasonal side consisted of an overview of the DMPTool. At the time, templates compatible with NIH requirements were still in development; however, several contributing institutions submitted helpful suggestions and interpretations to generate a basic plan in line with NIH guidelines.

Figure 1. This flyer was originally created in August 2022; it was included in the DMPTool EdGroup Flyers, DMPTool Working Group on NIH Data Management and Sharing Plans (Praetzellis et al., 2023).

Dessert

- The dessert course of the initial feast, an expanded LibGuide, provided a local portal of information: downloadable copies of the appetizer and main course, links to NIH-provided materials, a basic overview of research data management with links to additional resources, and contact information for the chef kitchen, and other local restaurants.
- The LibGuide has been updated as the menu has evolved for subsequent feasts.

CHEF'S NOTES

Provide personal touches (e.g., humor, supporting visuals) to create the best feasting experience possible.

Assess the feast with formative inquiries about guests' experiences. This practice helps

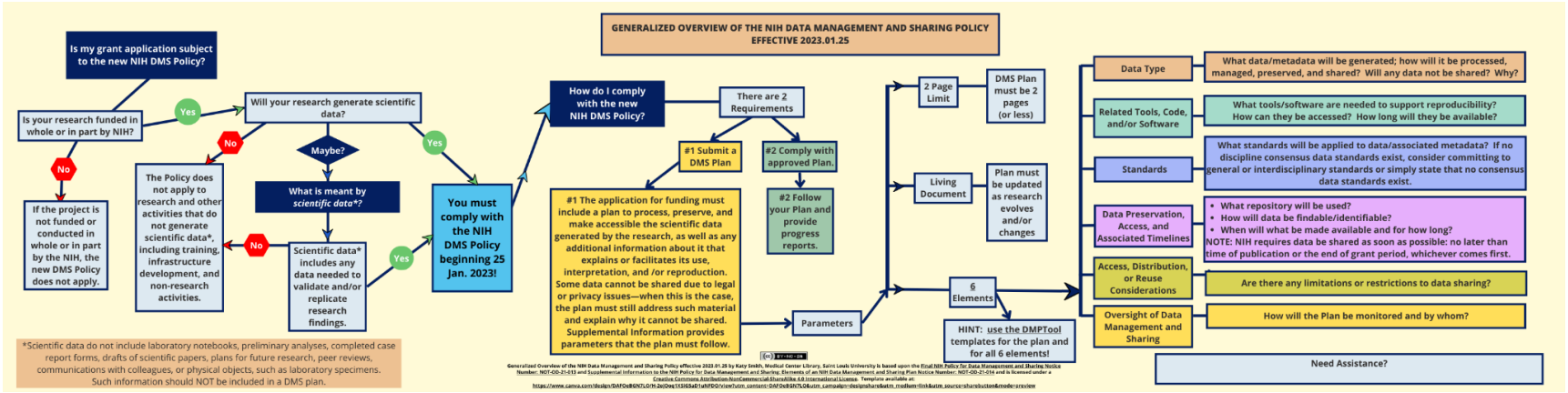

Figure 2. This infographic was created to streamline the process of determining the need for NIH DSMP compliance as well as to outline the policy requirements (Smith, 2023).

personalize each guest's experience, connects chefs and guests, and encourages direct feedback to the chef. Consider including an optional anonymous survey for additional feedback; reflect on all feedback to inform future menus.

Be proactive and keep up-to-date with innovations and advancements in culinary practices, kitchen equipment, and federal food regulations. Menus may require updates as policies and practices evolve.

When preparing for the initial feast, the chef was privileged to serve on two national working groups of data librarians and data scientists: the Working Group on NIH DMSP Guidance (https://osf.io/uadxr/) and the DMPTool Working Group on NIH Data Management and Sharing Plans (https://osf.io/c43yq/). The groups prepared extensive, multicourse feasts that helped the chef understand and embrace open data mandates. The chef gratefully acknowledges these groups of amazing colleagues.

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No Substitutions:

Preparing for Open Science Training by Sharing Your Own Research Protocol

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NUTRITION INFORMATION

As the open science movement grows, librarians have many opportunities to advocate and provide support for sharing research outputs beyond journal articles. Examples of important research outputs include preprints, datasets, software, and research methods protocols. Research methods protocols may include procedures, guidelines, best practices, workflows, or safety precautions of a study.

This is a recipe for openly sharing a completed research protocol through two platforms, protocols.io and the Open Science Framework, and creating a workshop on open science, with a focus on how to share a research protocol.

LEARNING OUTCOMES

After following this recipe, readers will be able to:

- define research protocols and describe the benefits of openly sharing them;
- explain the nuances of protocols.io and the Open Science Framework, in order to make recommendations and answer questions from researchers; and
- create a workshop that introduces open science and research protocol sharing, informed by the experience of sharing their own research protocol.

COOKING TIME

Plan for approximately one hour to compare the two platforms and choose one. The time to upload the protocol will vary depending on the length of the protocol, which platform was chosen, and the format of how the protocol will be shared (i.e., static PDF versus executable checklist). Only the Open Science Framework allows for immediate release of a protocol; protocols.io requires that the submitted protocol go through a basic screening process, which could add several days to the cooking time.

Developing the workshop, including learning outcomes, a teaching outline, slides, and a sample protocol, will take approximately two weeks.

DIETARY GUIDELINES

Sharing research protocols openly, an essential open science practice, makes them available to all researchers, providing transparency on the step-by-step process of how a study was conducted and making the research more reproducible for others interested in replicating results or adapting parts of it for their own projects.

This recipe ties into two frames of the ACRL *Framework for Information Literacy for Higher Education*:

- Information Creation as a Process: It's important to recognize that information disseminated via a platform/repository may be viewed differently than those in a peer-reviewed journal. A librarian should be prepared to have such discussions with researchers.
- Scholarship as Conversation: It's also important to recognize that many research outputs, including research protocols, are scholarship and contribute to the research conversation. Librarians sharing their own protocols and educating researchers can contribute to the embrace of open science principles on their campuses and beyond.

INGREDIENTS AND EQUIPMENT

To share a research protocol, you will need:

- a completed protocol;
- an ORCID (Open Researcher and Contributor ID);

- a selected Creative Commons license; and
- a selected protocol platform or repository

PREPARATION

Going through the hands-on process of sharing your own protocol is not only an effective way to learn how these platforms work in preparation for developing a workshop but it also demonstrates your commitment to open science and can impact the field of librarianship by allowing others to read, share, and build upon your work.

1. Decide on a protocol from your own work that you would like to share. This could be a protocol on publication data cleaning in Excel (Gabrielson & Turner, 2022), methods for de-duplicating citations in a bibliographic management software, or a checklist used when evaluating new acquisitions.
2. If you do not already have an ORCID, a free persistent identifier, register for one. Each of the protocol platforms can link to an author's ORCID profile and automatically push the protocol citation to the Works section of an ORCID record. This integration allows ORCID records to be kept up to date without administrative burden and enhances the discoverability of the shared protocol.
3. Determine the conditions for how your protocol can be reused. Each protocol platform can display a Creative Commons license to alert readers of the permissions granted to them under copyright law. There are six different license types, the most open being CC BY, which allows others to reuse a protocol for any purpose, if credit is given; protocols.io requires that all protocols are posted under a CC BY license, while the Open Science Framework gives authors a choice between CC BY, uploading a custom license, or denoting a C0 public domain dedication where an author gives up their copyright and puts their protocol into the public domain without any conditions. See the CC license chooser for guidance on which license is most appropriate for your protocol, and remember that a license may not be revoked (Creative Commons, n.d.).

Table 1. *Platform Descriptions*

Platforms	Detailed Description
protocols.io	protocols.io is a platform that allows authors to build and share a methods protocol. Its scope is broad, making it a good choice for librarians, information professionals, and other researchers. Protocols are screened before they are publicly posted to help reduce the risk of misinformation and non-science becoming widely shared and used, but the screening process is not as rigorous as formal peer review. A wide variety of multimedia can be embedded within these protocols, including images, audio, videos, and timers. protocols.io is interoperable with ORCID and requires a CC BY license, so it aligns well with open science principles. While changes to an existing protocol cannot be made after posting, authors can post a new version of the protocol that gets assigned its own unique DOI and is accessible from the previous version. Protocols can be displayed as a dynamic webpage with an interactive table of contents or as a static PDF file. protocols.io also allows you to reserve a DOI in case you're not ready to post the protocol publicly yet reviewers to read your protocol while it's still private if you included a link in the methods section of a paper.
Open Science Framework (OSF)	OSF is an online research management tool that is designed to enable researchers to plan, collect, and share their work throughout the entire research life cycle. While OSF can be used for sharing individual protocols, it's often used for whole projects, and it allows researchers to include components such as code, data, research notes, and preprints. With OSF, shared items are made immediately available once the author makes them public (no screening process). Authors can pick the license that fits their work best (including CC BY) or upload a custom one. Protocols can be shared on OSF in any file format, including Word, text, or PDF, and OSF has built-in version control and retains all copies of uploaded files. It's worth noting that versions of files with the same file name do not receive a new DOI, but previous versions are viewable and downloadable.

4. Choose a platform for sharing your protocol. Use the summaries of scope, features, and author guidelines in tables 1 and 2 to inform your decision.
5. Follow the individual instructions/guidance provided on the platform's website to upload, reserve a DOI (if necessary), and share the protocol.

COOKING METHOD

Now that you have done the prep work and shared your own protocol, you can take this knowledge and practical experience to teach others. An hour-long library workshop is a great learning opportunity to introduce sharing protocols to students, faculty, and research staff.

1. Take a few minutes in the beginning of your class to provide a definition and overview of open science. Emphasize that open science creates greater research transparency and reproducibility and enables equitable access to all research outputs. Use polling software or open discussion and have attendees share their views on open science. Ask specifically if they have ever shared any works openly or wished that a colleague would have.
2. Next, shift your focus to research protocols. Define protocols and outline the benefits of sharing. Explain how sharing protocols supports the principles of open science and how it can also increase the visibility of authors' work. (See the Chef's Notes section below for more talking points on the benefits of sharing protocols.) Share any experiences you might

Table 2. *Platform Features Compared*

	protocols.io	**Open Science Framework**
URL	https://www.protocols.io/	https://osf.io/
About	For-profit platform acquired by Springer Nature in 2023	Maintained and developed by the Center for Open Science (COS), a nonprofit organization, and supported through grants from a variety of funders, including federal agencies, private foundations, and commercial entities
Subject scope	Science methods, assays, clinical trials, operational procedures, and checklists	Disciplinary agnostic
Cost	Free Subscription plan for private protocols	Free for 5GB (private) Free for 50GB (public) More storage available for purchase
Privacy settings	Yes	Yes
Posting time	1-2 days, must pass basic screening	Immediate
Collaborative authoring in an online workspace	Yes	Yes
Metrics	Views Exports Bookmarks Copies Forks Trackable by Altmetric	Views Downloads Links Copies Forks
Community engagement	Public commenting Social media sharing Copying Forking Citable	Public commenting Social media sharing Citable
DOI	Yes	Yes
ORCID	Links to ORCID record Sign in with ORCID Writes to ORCID record	Links to ORCID record Sign in with ORCID Writes to ORCID record
Licensing	CC BY	Any Creative Commons license via drop-down menu or custom license

have had so far with sharing your own protocol. Were you able to include the DOI of your protocol in a manuscript, or has a colleague reached out to collaborate?

3. Now provide a summary of the two platforms. Highlight any features unique to each platform and describe why you selected the platform that you did.
4. Be sure to have a slide on how to select a Creative Commons license and register for an ORCID. Encourage attendees to sign up for an ORCID if they haven't already.
5. Conduct a live demonstration and encourage hands-on participation, allowing time for attendees to register for an account (you may want to have a sample protocol file for attendees to use). Show attendees how they can upload or create a protocol in the workspace and how they can share their protocol when it is finished. This is a great time to show your own shared protocol. What does it look like live? How can others cite a protocol like this one? What metrics are visible publicly, and which are visible to the authors only?
6. Allow at least five to ten minutes for follow-up questions, discussion, and/or evaluations. Offer one-on-one consultations for anyone who wants to make their own research protocol openly available.

CHEF'S NOTES

This recipe focuses on sharing protocols openly through platforms to promote open science. Protocols can also be published in peer-reviewed journals, through article types such as "lab protocols" or "methods". Some journals solely focus on publishing research protocols, including *bio-protocol*, *Current Protocols*, and *Nature Protocols*. *JoVE* would also be a strong option if a protocol would translate well to a video.

Sharing protocols via a peer-reviewed journal may be appealing for faculty whose tenure and promotion applications reward peer-reviewed publications, even though protocols that go through the peer-review process may take longer to be disseminated, and many features of the platforms, such as forking or dynamic interfaces that allows researchers to "run" a protocol, are not available in journals. We hope that such systems will change over time, but in the meantime, we encourage the selection of a gold or hybrid open access journal so that the protocol is available without a subscription. (Note that an article processing charge (APC) would have to be paid to make the protocol freely available.)

It may be possible for authors to share protocols via a platform and also publish in a journal. For example, protocols.io partnered with *PLOS ONE* so that protocols in the platform can be integrated into peer-reviewed lab protocols and study protocols (Official PLOS Blog, 2021).

The full benefit of making a protocol open cannot be realized without linkages and promotion. Protocols should be linked to and cited within any manuscript that uses the protocol's methodology, allowing people to easily refer to the full-text protocol for details (transparency), to replicate the work (reproducibility), and/or to cite the protocol in their own work. To increase the discoverability of protocols, they can also be shared on social media.

A protocol should also be included in a researcher's impact narrative and/or CV. Whether a researcher is applying for tenure and promotion or grant funding, metrics associated with a shared protocol will help demonstrate its impact. Many protocol platforms support tracking by Altmetric, as well as other built-in analytics for page views, downloads, and other metrics that can help you communicate the impact of their protocol (see table 2).

ADDITIONAL RESOURCES

- ORCID: https://orcid.org/
- Creative Commons: https://creativecommons.org/

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Increasing Visibility and Discoverability of Electronic Theses and Dissertations Using Linked Open Data:

A Simple Process for Uploading Metadata to Wikidata

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NUTRITION INFORMATION

Wikidata is a freely available knowledge graph that, like Wikipedia, can be edited by anyone. It is multilingual, supports Linked Open Data as a mechanism for discovery and exploration, and is in common use worldwide. Because Wikidata is now commonly used as a data source by data aggregators like Google, it can be a tool for making metadata about electronic theses and dissertations (ETDs) more open and easily discoverable. Wikidata was developed in part to make it easier to provide citations for Wikipedia, so including theses in Wikidata also lowers the barriers for citing them as sources in Wikipedia articles.

Wikidata has grown beyond its original purpose and is now widely used by a well-developed user community committed to open data. That community is continually developing new products based on data from Wikidata and is working towards making it easier for new members of the community to contribute. This recipe describes a way to lower the barrier for entry to increase participation in the Wikidata community.

One reason for Wikidata's popularity is its very easy-to-use human interface. However, uploading large numbers of items can be very time consuming and labor intensive. This recipe will walk cooks through an alternative mechanism for creating Wikidata items using spreadsheets and a tool called VanderBot. Unlike similar tools for uploading from spreadsheets, VanderBot also makes it possible to delete or change large numbers of statements and references after they have been uploaded.

LEARNING OUTCOMES

By following this recipe, cooks will:

- gain practical experience with Linked Open Data by incorporating spreadsheet data into a well-known knowledge graph; and
- learn general principles of how Wikidata models and describes publications through preparing and uploading ETD metadata.

NUMBER SERVED

This recipe can be used to upload metadata for ETDs to serve Internet users around the world and provide greater exposure for thesis authors —with no expiration date! The number of ETDs uploaded can range from less than a hundred into the thousands. The upward limit is really based on the number of rows of a spreadsheet with which a human can reasonably interact.

COOKING TIME

Depending on how many software applications need to be downloaded and your familiarity with installing software, plan for fifteen minutes to an hour to prepare those ingredients.

Getting a Wikimedia account and preparing the bot password should take about fifteen minutes for someone familiar with using a text editor. Cooks that are unfamiliar with Wikidata should probably spend at least an hour exploring it before undertaking the recipe.

After the necessary software is installed, the cooking time will depend largely on the amount of time necessary to prepare the data. If the system that manages the ETD content provides clean CSV exports, the time will mostly depend on how long it takes to copy and paste the exported data into the spread-

sheet (see Cooking Method section, step 3). That may take fifteen minutes to an hour depending on how clean the data are and the cook's familiarity with using spreadsheets.

The time required to do the actual upload is only 1.25 seconds per thesis.

DIETARY GUIDELINES

Wikipedia has become increasingly strict about requiring citations to support assertions made in its articles. Once a thesis is included in Wikidata with its supporting references, it becomes easy to cite in Wikipedia. Each item in Wikidata has a unique Q ID, an identifier that can be used in Wikipedia's {{Cite Q}} template to automatically generate a citation of the thesis. Wikidata is also commonly used as a data source by large information aggregators—to support Google's Knowledge Graph, for example—so including theses in Wikidata improves their discoverability.

INGREDIENTS AND EQUIPMENT

For help with any of the tasks in the following sections, see the Chef's Notes section. Refer to the figure to see how the ingredients blend together.

To be successful in completing this recipe, cooks should be familiar with their computer's file system and should have a basic knowledge of giving commands in their computer's console.

Before starting this recipe, make sure that the computer has Python 3 installed. Although the recipe does not involve coding in Python, the Python application is necessary to run the VanderBot script. Cooks may also need to install the Python requests library.

A spreadsheet editor that works well with CSV files is also required. Although Excel may be used, cooks are likely to eventually run into problems with automatic text conversion and encodings of non-Latin characters. The open source LibreOffice application is recommended for reliably editing CSV files, particularly those that will be accessed by scripts. To set up the configuration of the spreadsheet, cooks will need to have a good code editor. The free Visual Studio Code (VS Code) application is recommended.

The last required ingredients are the VanderBot and convert_config_to_metadata_schema.py scripts. They should be downloaded into the directory where the data will be kept (the working directory).

PREPARATION

Cooks that don't already have a Wikimedia account will need to create one. The same account works across Wikipedia, Wikidata, and Wikimedia Commons, so an account on any of these platforms will be sufficient. Writing to the Wikidata API also requires having a bot username and password, which need to be saved in the home directory of the computer.

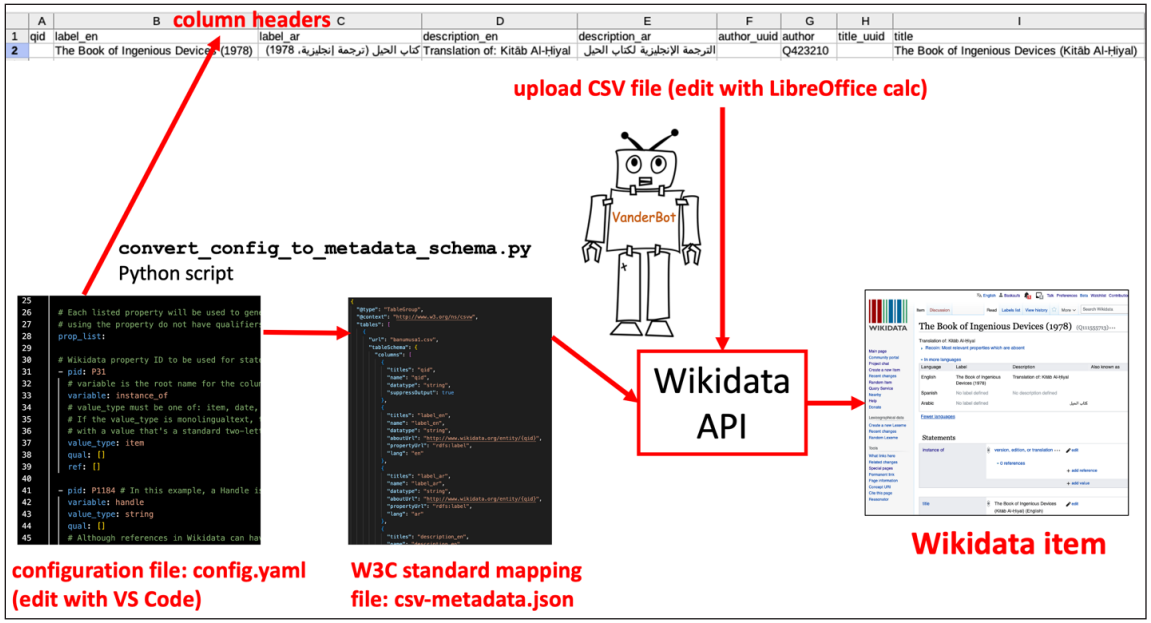

Figure 1. Relationship among files involved in the workflow for uploading to Wikidata using VanderBot

It is also helpful for the cook to be familiar with the user interface on the Wikidata website. An example of a doctoral thesis item that is similar to the ones created through this recipe can be found at https://www.wikidata.org/wiki/Q111636714 .

NOTE: to avoid creating duplicate items, the cook should ensure that no one from their institution has already uploaded the dissertations and theses being considered for upload. It is probably a good idea to search for several using the Wikidata search box (upper right corner) before undertaking a mass upload.

COOKING METHOD

1. **Extract data about the theses into a spreadsheet.** This step will be easiest if the ETDs are managed using a content management system (e.g., DSpace) that can export the metadata as a spreadsheet. The preferred export format is CSV, although if an Excel export is possible, the .xlsx file can be opened in Excel and saved as a CSV. The exported data should have a row for each thesis or dissertation and contain columns with the following metadata: title, publication date in ISO 8601 format (YYYY-MM-DD; may contain only the year or the year and month), thesis author name (one author only), and a unique URL identifier for the thesis. Typically, a DOI or Handle will be assigned, and these can be expressed as URL identifiers. Otherwise, provide a stable URL.
2. **Modify the configuration file to include the desired properties.** The columns in the CSV file used in the upload are mapped to Wikidata properties using a simple YAML configuration file. Download the example file from https://github.com/HeardLibrary/linked-data/blob/master/etd/config.yaml into the working directory. Open the downloaded file using a code editor. Most of the settings can be left as they are. The property ID in line 41 is set for P1184 (Handle ID). If you are using a DOI, change this to P356 (DOI) and change the value in line 42 from "handle" to "doi". If using some other kind of persistent URL identifier, delete lines 41 through 53.
3. **Generate column headers for the upload CSV file.** After saving the modified configuration file, use the convert_config_to_metadata_schema.py script downloaded as an ingredient to generate column headers of an empty CSV. In the terminal application, navigate to the working directory and issue the following command (replace "python" with "python3" if your system requires it):

    ```
    python convert_config_to_
    metadata_schema.py
    ```

    The script will generate two files. The file csv-metadata.json is a W3C standard description file used by VanderBot to understand the structure of the upload CSV. The second file is a file named htheses.csv that contains the header row for the upload CSV file that will be created. The "h" at the start of the filename is to prevent overwriting any existing theses.csv file, so remove the "h" from the filename before using the file.
4. **Adding the thesis data to the upload CSV.** Open the upload CSV file (theses.csv) and the CSV containing the extracted thesis metadata using the spreadsheet editor software. The upload CSV contains a lot of columns that are used by VanderBot for record keeping, so many do not need to be filled in by the cook. These are the ones that need to filled:
    - **label_en**. Paste in the titles of the theses copied from the extracted data CSV. (For a language other than English, this column name would have a different language tag, e.g. "label_fr".)
    - **title**. Paste in the titles of the theses. Note: this system is limited to one title language per spreadsheet (the one designated in line 94 of the configuration file).
    - **description_en**. Paste in either "doctoral dissertation" or "master's thesis" as appropriate for the work.
    - **instance_of**. Paste in "Q187685" for doctoral dissertations or "Q1907875" for master's theses.
    - **handle** (or **doi** if you changed this in the configuration). Paste in the raw Handle strings (or raw DOI strings). That is, use "1803/11165" rather than the URL version "https://hdl.handle.net/1803/11165".
    - **full_text_available**. Paste the URL versions of the Handle, DOI, or permanent URL, e.g. "https://hdl.handle.net/1803/11165".
    - **author_string**. Paste the author

names. The convention is to put the given name first, surname last for languages where that is the norm.
- **published_val**. Paste the publication date (must be in ISO 8601 format; can be the year only).
- **language**. Paste in "Q1860" for English. For other languages, search for the Q ID in Wikidata.
- **dissert_submit_to**. Look up the Q ID for the university to which the thesis was submitted. For example, use "Q29052" for Vanderbilt University.

In each reference date column (columns whose name ends in "_ref1_retrieved_val"), paste the full ISO 8601 date for when the metadata was exported. For example: "2022-02-18" for February 18, 2022. There should be seven of these retrieved date columns if no columns were removed from the configuration file.

In each reference URL column (columns whose name ends in "_ref1_referenceUrl"), paste the same URL used in the full_text_available column, e.g. "https://hdl.handle.net/1803/11165".

5. **Sandbox upload.** If the qid column in a row of the spreadsheet is empty, VanderBot creates a new item. If that column in a row contains an item Q ID, the statements are added to that existing item. To ensure that everything is working as planned, it's best to try uploading statements to one of the existing Wikidata sandbox items. Save a copy of the upload spreadsheet under a different name. In the original copy, delete all of the lines except for the first one, then enter "Q4115189" in the qid column. Be sure to save and close the CSV file after you edit it. View the sandbox item at https://www.wikidata.org/wiki/Q4115189. In the terminal application, issue the command:

```
python vanderbot.py
```

If the script finishes successfully, refresh the sandbox item web page to verify that the changes made are what was expected. (To get rid of the test changes, click on the "View history" link at the top of the sandbox item page, then click "undo" by the test revision.) After reopening the upload spreadsheet, the identifiers VanderBot added after the upload will be visible.

If the script does not finish successfully, look at any error messages to see what needs to be corrected.

6. **Test upload.** Now try creating a new item for the first thesis in the spreadsheet. Repeat what was done in the previous step (make a copy of the full data CSV, delete all but the first line, and name it theses.csv), but this time leave the qid column empty. Save and close the CSV. Run the VanderBot script again. If the upload was successful, look at the qid column of your spreadsheet to see what Q ID was assigned to the new item. Use that Q ID to look up the new item and verify that everything is as you expected.
7. **Upload the actual data.** Open the copy of the upload data that was saved under another name and open the theses.csv file just used for the test upload. Copy and paste the first line of data from theses.csv to the CSV copy so that the assigned identifiers will be in the full copy. Save the CSV copy, delete the single-line theses.csv file and rename the copy to theses.csv. The next time VanderBot is run, it will upload the data for all of the theses (skipping the first line since its identifiers are already filled in). Note: "newbie" users are users who have accounts less than four days old and who have done fewer than fifty edits. If a cook is a newbie user, they will be subject to a slower edit rate (eight edits per minute). In order to avoid getting blocked, newbies should use the apisleep option to add a longer value of eight seconds between edits when they run VanderBot:

```
python vanderbot.py
--apisleep 8
```

Cooks that are not new users can run the script without the apisleep option to write at the normal rate of fifty edits per minute.

CHEF'S NOTES

Test uploads help to avoid a mess in the kitchen. A small number of errors can be corrected using the Wikidata user interface. However, if a cook discovers that they've made many mistakes in their uploads, they can delete statements or references by providing the identifier information stored

by VanderBot in the upload CSV to a related script called VanderDeleteBot. (For information about the VanderDeleteBot script, visit https://github.com/HeardLibrary/linked-data/blob/master/vanderbot/vanderdeletebot.md.) Corrected statements can then be added using VanderBot.

If cooks discover that they have created duplicate thesis items by mistake, they can't delete them, but they can merge the duplicate items by using the "Merge with…" tool under the "More" menu at the top of the Wikidata page of the duplicate item.

In this upload process, the name string for the author was used. If the author has a Wikidata item, it is best to link to it instead. Author Disambiguator (https://author-disambiguator.toolforge.org/) is a good tool for making those links.

Notes on Ingredients and Equipment

- If you are unfamiliar with your computer's file system or with giving commands in your computer's console, see Lessons 1, 2, and 6 at http://vanderbi.lt/computer.
- If you don't know whether you already have Python 3 or if you need to install it, there are detailed instructions in the "Before starting" section at http://vanderbi.lt/ld4vb. That page also has instructions for installing the "requests" library.
- To download LibreOffice, visit https://www.libreoffice.org/. The Visual Studio Code (VS Code) application is available for free at https://code.visualstudio.com/download.
- The VanderBot script can be downloaded from https://github.com/HeardLibrary/linked-data/blob/master/vanderbot/vanderbot.py. The convert_config_to_metadata_schema.py script can be downloaded from https://github.com/HeardLibrary/linked-data/blob/master/vanderbot/convert_config_to_metadata_schema.py. If you haven't downloaded a file from GitHub before, you can see a video explaining how in the "Downloading the VanderBot script" section at http://vanderbi.lt/ld4vb.

Notes on Preparation

- To create a Wikimedia account, visit https://en.wikipedia.org/wiki/Special:CreateAccount. There are instructions (with videos) for creating a bot username and password in the Preparation section at http://vanderbi.lt/ld4vb.
- For some beginner video lessons on Wikidata (available in English, Spanish, and Chinese), visit https://www.learnwikidata.net/.

Cooking Up a Cloud-Based Research Environment:

A Taste of Reproducible Computational Text Analysis With Open Data

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NUTRITION INFORMATION

This recipe cooks up a reproducible, cloud-based research environment using GitHub, MyBinder, Jupyter Notebooks, and an institutional data repository. The recipe is put into practice using an example that teaches humanities students about text mining in a hands-on, try-it-yourself approach. Figure 1 shows how the different pieces relate to each other conceptually.

The purpose of this recipe is to present a method of leveraging freely available resources that lowers the barrier for hands-on learning of data science principles and practices in a workshop setting. Precious workshop time is often eaten away helping students set up the required computational environments on their own laptops, and the variety of different platforms and operating systems students use often leads to idiosyncratic technical issues. For example, the student may observe error messages that the instructor does not. There may be limitations in the computational capacity of students' hardware, hindering their ability to run the desired exercises. Leveraging freely available cloud resources helps ensure everyone has access to the same computational environment with the same capabilities, regardless of what platform and hardware they choose to use.

LEARNING OUTCOMES

After reading this recipe, cooks will understand:

- how tools and resources like GitHub, Jupyter Notebooks, Binder, and data repositories can be leveraged to create reproducible workflows that can be freely shared and executed in the cloud;
- how to prepare and curate data for archiving in a data repository to enable the above activities; and
- how to structure learning-focused computational projects targeted at humanities researchers.

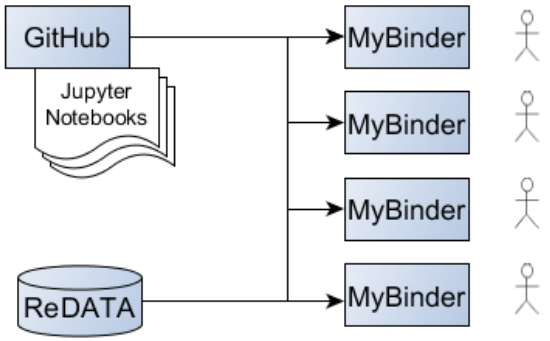

Figure 1. This recipe demonstrates how GitHub, the MyBinder service, and a data repository can be leveraged to teach an introductory text mining workshop. With a single click, each student generates their own private environment in the MyBinder system. That environment runs a copy of the Jupyter Notebooks stored in the instructor's GitHub repository and a copy of the data from ReDATA so that each student can modify and run the exercises individually.

NUMBER SERVED

In the teaching scenario this recipe uses as an example, the resulting lesson is suitable for ten to fifteen students in a synchronous session. The computational environment (Binder-hosted Jupyter Notebooks) will host many more simultaneous users (roughly 100), but the hands-on nature of the lesson warrants a considerably smaller synchronous audience. However, the teaching materials are structured so that students can also use them to self-teach asynchronously.

In the general case, the number served depends on the complexity of the computational environment and the size of the data. (See the Chef's Notes section below for general limitations.)

COOKING TIME

If using the example teaching materials with minimal modification, budget about two hours for a live workshop. If preparing your

own materials, the time will naturally vary. For reference, in creating the example materials:

- planning and developing the lesson took approximately forty hours;
- data cleaning and preparation took about twenty hours, including the time taken to deposit the data in a repository; and
- data curation by data repository staff took approximately two hours.

DIETARY GUIDELINES

Research that can be not only understood but also reused by others is often lauded as one of the main objectives of sharing research data, code, and methods. However, this goal is seldom fully realized. One way to help researchers realize that goal is by making it as easy as possible to set up the required computational environment to run a specific piece of software. Having the same environment regardless of the specific system the software is being run on is important for reproducibility. However, achieving the goal of a portable environment is not trivial.

In the context of disciplines that do not have a computational tradition, this issue can sometimes present an insurmountable barrier to enabling frictionless data reuse. The same barrier arises in the context of teaching computational research methods to university students. In that case, the main goal is reducing the struggle to get a working computational environment so the student can focus on the core part of a lesson. This recipe demonstrates how by using free, cloud-based resources, the onus of setting up a working computational environment that follows open science and reproducibility principles can be shifted from students to instructor. This lowers the barrier for students to learn and helps the instructor deliver the learning objectives more effectively. This approach also exposes students to the benefits of open data and shows them the benefits of working reproducibly.

INGREDIENTS AND EQUIPMENT

See table 1 for the list of ingredients needed to construct a cloud-based, reproducible computational environment for teaching. The table lists the ingredients, their purpose, and how the ingredients are used in the text mining example that is referenced throughout this recipe. The session can be delivered by one person. An assistant (to help students with specific questions or technical issues) is recommended but not required.

Table 1. *List of Ingredients*

Ingredient	Purpose	Text mining example
GitHub, https://github.com/	Hosting of the lesson materials. Provides a freely accessible, widely used platform where others can easily view and adapt the materials.	Borderlands newspaper data mining GitHub repository hosting all the lesson materials. https://github.com/jcoliver/dig-coll-borderlands
Jupyter Notebooks, https://jupyter.org/	An open source, graphical, in-browser software development environment that makes coding more approachable by mixing interactive code blocks with explanatory text. It is widely used in the data science community.	Introduction to Text Mining notebook (hosted on the above GitHub repository, where there are additional notebooks. Note that GitHub does not execute notebooks, it merely displays a static preview.) https://github.com/jcoliver/dig-coll-borderlands/blob/main/Text-Mining-Short.ipynb
MyBinder, https://mybinder.org/	Provides free computational resources that allow execution of Jupyter Notebooks stored in repositories	Any of the Jupyter notebooks in the above GitHub repository can be executed in-browser by MyBinder with one click, e.g., Text mining template, https://mybinder.org/v2/gh/jcoliver/dig-coll-borderlands/main?filepath=Text-Mining-Template.ipynb
Open Data	The actual data used in the lesson or analysis in question	A subset of the newspapers from the Library of Congress Chronicling America project, https://chroniclingamerica.loc.gov/newspapers/. The 1.8 GB subset used in the lesson is archived in the University of Arizona's ReDATA repository. https://doi.org/10.25422/azu.data.12735992

PREPARATION

The effort required for a successful recipe is mostly exerted during the preparation stage. When successfully prepared, the cooking process is relatively straightforward. Generally speaking, preparation involves identifying the objectives, locating appropriate data, cleaning and structuring the data, writing code that can achieve the objective in a repeatable manner, and documenting the process. In reality, these steps are often nonlinear and iterative, but for the text mining case in this recipe, they are presented linearly for clarity.

IDENTIFYING OBJECTIVES

The main objective of this lesson is to teach novices some introductory text mining concepts in an accessible way. Newspapers are a source of inquiry for a variety of disciplines, and they serve as useful primary sources in the undergraduate classroom. As data, newspapers become a vital source for revealing trends within and across communities over time.

The perspective of "newspapers as data" introduces computational approaches to undergraduate students in the humanities and social sciences who may not have the opportunity to work with text in a quantitative and computational manner. To make the lesson more accessible, much of the computational infrastructure requirements are moved *off* the plate of the students. The only requirement is access to a web browser. The lesson focuses on six learning objectives. After the lesson, students will be able to:

- explain the difference between a code block and a text block in Jupyter Notebooks;
- write a short command in Python and execute the command;
- execute prewritten Python code to create a plot of word frequency through time;
- describe how to choose search words;
- update Python code to perform word frequency calculations on different newspaper titles; and
- create a plot showing word frequency over time on a chosen newspaper and time frame.

LOCATING APPROPRIATE DATA

The Chronicling America resource from the Library of Congress is a readily available corpus that is suitable for text mining and has the potential to generate broad student interest. In this particular recipe, the newspapers focus on the geographic region of the authors' institution and faculty interests and include titles published in English and Spanish.

DATA PREPARATION

The precise data gathering and cleaning steps vary depending on the objectives and data identified in the previous steps, but generally speaking, data that has been arranged and normalized ahead of time is best. For this lesson, pre-preparation consists of using the Chronicling America API to programmatically download individual pages from eight newspapers, encoding them as UTF-8, and concatenating all pages within an issue. Data files are then organized into one folder for each newspaper title and one text file for each issue. Preparation scripts for these steps are available at https://github.com/jcoliver/borderlands-newspapers.

The lesson data needs to be stored in an internet-accessible location for this recipe to work; we recommend using a data repository. In this particular lesson, the cleaned data are archived in the University of Arizona's institutional data repository (ReDATA), where the dataset underwent a curatorial review by repository staff. This involved adding additional documentation to the dataset so it could stand alone, adding contributorship information, and correcting issues with data consistency. While the dataset could have been placed in any internet-accessible storage location (e.g., Google Drive), it was placed in a data repository in order to (a) adhere to the FAIR principles (especially around the findability and persistence that a dedicated data repository can provide) and (b), to expose students to data repositories and how they can be leveraged in an analysis pipeline.

WRITING SOFTWARE

Writing the code so that it produces the same results on the instructor's local computer and in the MyBinder system takes some planning. When developing the code locally, there are general recommended practices that should be followed to increase the likelihood of initial success and reduce the need to iterate on

the software once it's executed in MyBinder. The text mining example is written in Python, so these tips are given with that in mind:

- Ensure dependencies are captured. The base Python environment created by MyBinder does not include any external libraries. All external libraries must be installed. MyBinder reads a file in the root of the GitHub repository called requirements.txt or environment.yml to install any requested Python dependencies. Explaining how these are created is outside the scope of this recipe, but the information can be found in the MyBinder documentation (https://mybinder.readthedocs.io/en/latest/tutorials/reproducibility.html). Refer to the requirements.txt (https://github.com/jcoliver/dig-coll-borderlands/blob/main/requirements.txt) in the text mining lesson for an example.
- Always use relative paths (relative to the Python code). The absolute location of files in the filesystem will change when running code in MyBinder.
- Familiarize yourself with how to programmatically download data files. In the text mining Jupyter Notebooks, the data is downloaded directly from the Re-DATA repository as one of the first steps. For teaching purposes, smaller subsets of the entire dataset are included directly in the GitHub repository.
- Since one of the main purposes of Jupyter Notebooks is the ability to include explanatory text alongside the code in one executable file, make use of that functionality to explain the purpose of each block of code, how to use it, and how to interpret the results.

COOKING METHOD

To use this lesson as a student:

1. Go to the Borderlands newspaper data mining GitHub repository (https://github.com/jcoliver/dig-coll-borderlands).
2. Scroll down and click one of the four Launch Binder buttons, e.g., Introduction to text mining (short).
3. The MyBinder service will launch and begin creating the environment. (It may take a few minutes the first time.)
4. When the creation process is complete, you will see a running Jupyter Notebook with a guided set of instructions for the actual text mining lesson.

To deliver the materials as an instructor:

1. A few days prior to the workshop, verify the code still runs as expected. Sometimes third-party libraries will get updated or the functionality of external services like MyBinder will change slightly. Verify that things still work as they did when they were created and initially tested.
2. Provide the materials to students the day before the lesson (optional).
3. Orient students to how the workshop will be conducted. In the text mining example, guide students through the use of Jupyter Notebooks, especially in regards to running code blocks.
4. Conduct the workshop. Cooking times will vary! With novice and heterogeneous audiences, there may be many questions and typos. It is important to afford time for these learning opportunities. Advanced audiences may work more quickly and require/provide more time for in-depth discussion.
5. At the end of the workshop, instruct students to close their browser windows. MyBinder will clean up the environment automatically.
6. If students want to save their changes, they must manually download via the Jupyter Notebook interface.
7. Direct students to additional resources, including a "sandbox" Jupyter Notebook for additional, self-directed learning.

CHEF'S NOTES

As a free service, MyBinder has limited resources. As a general rule, avoid creating exercises that rely on long-running, CPU-intensive calculations (i.e., ones that run for more than ten to twenty seconds or so), intensive input/output, or loading large amounts of data into memory (MyBinder limits the amount of RAM available to a maximum of 2 GB). Instead, use demonstration data as small as you can get away with, leaving working with the full data as an exercise to the learner. If resource-intensive operations cannot be avoided (perhaps you are demonstrating a machine learning model), avoid having students execute these operations all at once, as it may cause the service to become unresponsive.

Finally, depending on the nature of the

environment needed, the time needed for MyBinder to create the environment can vary, so make sure to factor that into the cooking time (note that MyBinder caches environments for a limited time so that subsequent requests to create the same environment will be faster).

A common pattern when using GitHub for teaching purposes is to have students clone the repository created by the instructor into their own account. There, the students can modify the code as needed. While students can certainly clone the instructor's repository and modify the code, the recommended pattern when using this recipe is to have students launch MyBinder with the instructor's repository. Students can then modify the code directly in the running Jupyter Notebook in MyBinder (their changes won't be saved when they close the MyBinder instance unless they download the modified notebook manually).

While GitHub and a dedicated data repository can be substituted for other options, replacements to MyBinder and Jupyter Notebooks (e.g., Google Colab) would require additional consideration. Variations of this recipe may include:

- hosting all data and code in GitHub, GitLab, or an arbitrary internet-accessible Git repository;
- hosting all data and code in certain MyBinder-compatible data repositories (e.g., Figshare, Harvard Dataverse, Zenodo);
- hosting data and code in separate repositories in any combination. The example text mining lessons do this: some Jupyter Notebooks pull demo/test data from the GitHub repository, while others pull the full dataset from the ReDATA repository;
- hosting data on an ordinary website instead of a data repository. This is the most flexible, but it leaves one open to the data being taken down at any moment. It also does not demonstrate the principles of reproducible and citable research. However, if using third-party data, it may be unavoidable if the terms of use of said data do not allow redistribution; and
- using Google Colab instead of MyBinder.

For non-testing/demo data, we recommend hosting data in a repository and hosting code in a dedicated code repository like GitHub.

ADDITIONAL RESOURCES

The following resources may be useful in preparing materials:

- The Zero-to-Binder tutorial, https://the-turing-way.netlify.app/communication/binder/zero-to-binder.html
- Limits and quotas for MyBinder, https://mybinder.readthedocs.io/en/latest/about/user-guidelines.html
- Top tips for making the most out of Binder, https://www.software.ac.uk/top-tip/top-tips-making-most-out-binder

Section 4.

Events

Cooking Up an Open Science Campus Symposium

***Annette Day**, Director of Collections, Discovery and Scholarly Communication, University of Nevada Las Vegas Libraries*

NUTRITION INFORMATION

This recipe describes the planning and development of a campus-wide symposium on open science concepts, purpose, practices and requirements, including funding mandates, for researchers and organizational stakeholders. Through presentations and facilitated conversation, the symposium will offer a clearer understanding of how the institution's researchers are currently incorporating open science practices and the barriers and challenges they encounter, both real and perceived. The symposium should provide leadership with a starting point for developing an organization-wide approach to open science that fits the local context.

The symposium that this recipe is based on was delivered as part of a multiday event hosted by the University of Nevada, Las Vegas (UNLV) Division of Research. The division oversees the research policies and practices of the university, including core facilities, sponsored programs, and research integrity.

The symposium was focused on three main tracks: high performance research computing, institutional research computing infrastructure, and open science. The open science content can also be delivered as a standalone symposium, but engaging campus partners and aligning with an organizational strategic emphasis like research infrastructure can provide a stronger contextual framework for open science.

LEARNING OUTCOMES

Readers will learn strategies for developing and leveraging campus partnerships and developing and hosting a campus-wide symposium to facilitate understanding and awareness of open science.

NUMBER SERVED

The symposium's goal is to share information and facilitate discussion across a broad array of disciplines. It is optimally designed for thirty-five to sixty people but could be scaled for a larger or smaller audience.

COOKING TIME

Preparation should be considered in the context of your local organization; not all preparation steps detailed in this recipe will be applicable. Preparation time will vary considerably across organizations, with estimates ranging from one to sixth months.

DIETARY GUIDELINES

Open science is a set of practices that enable openness, transparency, and accessibility in all aspects of research. Encouraging researchers to utilize open science practices can facilitate reproducible results, encourage faster research dissemination and knowledge creation, expand access to knowledge, and encourage equity among researchers around the world.

INGREDIENTS AND EQUIPMENT

- conference room/lecture hall/ballroom that supports flexible table arrangements for discussion
- presentation podium
- projection capabilities
- recording and streaming capabilities (if needed)
- presentation tools (e.g., Powerpoint, Google Slides)
- microphones
- presenters
- registration/RSVP software
- paper and pens for attendees
- stakeholders and collaborators, to be identified through the preparation steps below

PREPARATION

Some of these preparation steps should be taken well in advance of the symposium in order to build a necessary foundation of communication and engagement, which should be viewed as ongoing work for the library, both before and after the symposium.

1. Define open science.

Many researchers will be familiar with aspects of open science, such as open access, open data, or open educational resources,

or they may have heard phrases like open research. To ensure clarity for the symposium and for continued outreach, education, and engagement on the topic, it is essential to develop a definition of open science and what it encompasses. Researchers should understand how open science relates to what they already know about open practices so they can recognize how they may already be practicing elements of open science.

There are multiple definitions available from national organizations or federal agencies that can be used as a starting point for developing a definition for your local context. In the local context described in this recipe, we developed a definition that was broad, describing open science as a set of practices that enables openness, transparency, and accessibility in all aspects of research.

2. Understand the campus landscape.
Understanding more about how your organization currently supports and practices open science is essential. Activities and engagement with open science may be top-down led by campus leadership, vary from discipline to discipline across departments and colleges of the university, or be the outcome of advocacy and outreach from campus offices, sponsored programs, or the library. Some questions to consider when assessing your campus landscape:

- Are there positions, departments, or centers that support open science practices, including open data, open access publishing, open coding, etc.?
- Does your organization have articulated policies and strategies for open science (e.g., a research data policy including FAIR principles, an organizational open access publishing mandate, research integrity code that includes the principles of open science)?
- Is your organization aligned with national/international strategies and policies on open science?
- Is there a robust IT infrastructure, including high performance computing, cloud computing and data storage, and data and article repositories?
- Are there opportunities for skills training such as workshops, seminars, and funded professional development related to open practices? Is there any mandatory training for researchers that includes open science?
- Are there advocacy and communication efforts that enable the organization to better understand open science practices, benefits and impacts, and barriers/challenges?
- Does the organization monitor compliance with funding mandates?
- Are open science practices recognized in promotion/reward frameworks?

3. Engage campus partners.
Establishing connections with partners across the organization will inform symposium planning and development. Researchers may not always recognize the library's role in their research practices; engaging with campus partners can better position the library's skills and expertise in the research lifecycle. Developing these campus partnerships also enables the library to better understand the needs of its partners.

Begin with foundational outreach/engagement for research support:

- Informed by the landscape preparation step above, identify relevant partners. These may be at the college/department/office level or at an individual level (i.e., a researcher who is engaging in open practices).
- Develop talking points about the importance of increasing engagement with open science practices. Highlight research impact, policy changes, and funding mandates as key talking points.
- Develop talking points about how the library currently supports researchers in utilizing open science practices and tailor talking points for specific partners to highlight the synergies and benefits of working with the library.
- Identify how open science aligns with the strategic goals of potential campus partners. organization. Illustrating how this work can further the organization's aims is compelling for partners who may not see open science as a priority. For instance, positioning open science as a component of equity and inclusion can align it with an organization's work to strengthen diversity, equity, and inclusion.

Continue outreach for the symposium:

- Outline purpose of the symposium and contact campus partners to share this outline.
- Focus contact on campuspartners who will recognize themselves as stakeholders and understand the benefit of a symposium.
- Articulate what is needed from partners—budget, spaces, event planning, support, connections, or authority in the organization.

4. Establish a planning committee.

Form a planning committee, comprising stakeholders from across the organization, to plan symposium content, audience, format, and presenters and organize logistics like date, location, budget, and communication and outreach.

It's important to have representation from across the organization to ensure the different perspectives, expertise and needs of each area are included in symposium development. Different representatives will also have different influence in the organization and will have access to different organizational resources including spaces, budget, event planning staff and potential speakers. Leadership of the planning committee should be from a department/office that is a lead sponsor/advocate for the symposium, such as the library or the office of research.

5. Set symposium objectives and goals.

Articulating the purpose of the symposium through objectives and goals is a necessary step to inform content development and to enable assessment after the symposium.

Example objectives include:

- develop a shared understanding of what open science is and what it means for the organization
- share information about organizational resources to support open science
- share information about incentives and requirements for open science, including funding mandates, local practices, policies, and expectations
- highlight practitioners of open science at the organization
- connect researchers to support and resources on open science both in the local organization and externally
- connect researchers to each other
- understand organizational challenges and barriers to adopting open science, including infrastructure needs

Create a timeline for symposium planning, and assign responsibilities.

- Articulate audience for symposium.
- Determine available funding sources and propose a budget.
  - Funding need not be extensive or may not be needed if there are no refreshments, the speakers are internal, and the venue is free.
- Determine format of symposium—in-person, hybrid with live streaming, or fully virtual.
- Determine venue needs, taking into account:
  - room capacity
  - room layout flexibility—options to do classroom style or smaller group seating for discussions
  - technology needs—including AV and accessibility capabilities for in-person or hybrid events and platforms and technical support for hybrid or virtual events
  - catering needs if refreshments will be provided
- Identify a date for the symposium.
- Develop speaker agreements to be distributed to symposium presenters.
- Establish invite and RSVP procedures.
- Determine staffing needed for the event.

6. Identify the structure of the symposium.

Should there be a keynote speaker, facilitated discussions, break-out group sessions, resource presentations from campus offices, and/or a practitioner panel?

The symposium that this recipe is based on included:

- welcome from dean of libraries
- overview of open science and available campus resources
- funding landscape overview
- practitioner panel and open discussion
- campus resources overview and discussion
- facilitated group discussions on open science at the university—barriers, what

is needed, where next?

7. Identify potential presenters.
In order to identify possible presenters, consider reaching out to:

- subject specialist librarians, who will have knowledge and relationships with disciplinary faculty;
- associate deans for research, who will have knowledge of the research of the faculty in their college;
- department chairs/college deans, who can offer an overview of the activities of their college and department; and
- representatives from a variety of campus offices, who can identify colleagues to speak on procedures, infrastructure, funding mandates, and resources and support at the campus level.

Provide potential presenters with information on the purpose and goals of the symposium and how you anticipate presenters could speak to those goals. (See Chef's Notes section below for a sample email.)

8. Develop outreach and messaging and communication strategies.

- Develop agenda for symposium.
- Develop messaging to describe the purpose and goals of the symposium and share information about location, date, time, and methods to RSVP.
- Leverage campus partnerships to ensure messaging gets highlighted for specific constituencies (e.g., have college deans/department chairs send messaging to their faculty, have the research office send messaging highlighting the importance of attendance).
- Utilize social media and campus mailing lists.
- Decide on RSVP/reservation tools (e.g., Eventbrite, Google Forms, and Qualtrics).

COOKING METHOD

Ensure room is set up as planned

- Ensure AV is functioning correctly and presentations have been loaded
- Ensure that participants and facilitators are present and understand the agenda, technology, and their roles.
- If there is any virtual component to the symposium, ensure that presenters and attendees can access the platform and navigate its features.
  - For presenters it is advisable to set up a time prior to the symposium to ensure they are familiar with the technology.
  - For attendees it is recommended that a facilitator take a few minutes at the beginning of the symposium to inform attendees of relevant features and functionality (e.g., chat, breakout rooms) and when and how they can utilize them.
- Welcome participants as they arrive.
- Ask participants to sign registration sheets.
- Ensure agendas are available to participants, whether on paper, displayed on screens, or through a QR code or weblink.
- Ensure any handouts are available.
- Ensure paper and pens are available for participants.
- Ensure any participants who have notified organizers of accessibility needs have the support or equipment they requested.
- Ensure note takers are present.

After the symposium:

- Send thank you notes to presenters.
- Send follow-up emails to thank attendees and provide them with library contacts for further information and links to presentations and recordings. Include a link to a survey
- requesting feedback on the symposium, including logistics, content, learning outcomes, and suggestions for the future.
- Keep names of registrants as potential interested parties for related events and trainings in the future.
- Send out campus communication highlighting the event. Provide links to presentations and recordings and library contacts for individuals to follow up for further information/support.

CHEF'S NOTES

Here is a sample email to send to possible symposium presenters:

I am writing to ask for your help in identifying presenters for the open science portion of the symposium. For the purposes of this

symposium, we are using open science as an umbrella term for practices that "ensure the free availability and usability of scholarly publications, the data that result from research, and the methodologies, including code or algorithms, that were used to generate those data" (Nelson, 2022). Presentation topics may include but are not limited to the following:

- funder public access mandates—have you had experience fulfilling mandates that required the open sharing of data and research publications? What issues/challenges did you face (privacy, infrastructure, costs, etc)? What were the benefits/successes of open sharing?
- open data—have you used FAIR/CARE data in your research? How has using open data impacted your research? How have you accounted for open data in your data planning processes?
- open coding—have you openly shared your code in the past? Can you talk about sharing code and how it contributes to open science principles?
- open peer review—have you served as an open peer reviewer? What were your thoughts or experiences? How can open science practices assist the peer-review process?
- open educational resources—have you used open educational resources/open data/open software in your instruction? What were your experiences? Were they impacted at all by the move to remote learning during COVID?

The plan is for short presentations, around fifteen to thirty minutes (but that can be negotiated). If you have recommendations for presenters or would like to present yourself, please contact the organizers of this portion of the symposium (see below) by March 6th.

REFERENCES

Nelson, A. (2022, August 25). *Memorandum for the heads of executive departments and agencies*. Executive Office of the President, Office of Science and Technology Policy. https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-Access-Memo.pdf

From Raw to Well-Done:

A Successful Undergraduate Research Journey to Open Access

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NUTRITION INFORMATION

Promoting open access requires a strategic outreach plan that not only caters to faculty members and researchers' publishing activities but also extends to undergraduate students.

This recipe originated at Carnegie Mellon University in Qatar (CMU-Q), where undergraduates engage in research early in their academic journeys. Working alongside faculty mentors, students communicate the results of their research endeavors by creating posters that are presented at the end of the academic year in an event known as Meetings of the Minds (MotM), an undergraduate research symposium that replicates a poster session at a scientific conference. The MotM event is interdisciplinary in nature; it gives students from different majors a chance to come together, showcase their research, and practice communicating their findings to scientific and non-scientific audiences. Previously, documentation of student research activities was limited and sporadic. Therefore, in an effort to preserve and share students' scholarly output, CMU-Q library offered MotM participants the opportunity to deposit their digital posters to the university repository KiltHub.

This recipe aims to validate students' research efforts, safeguard their scholarly work, and educate them on the value and benefits of open access (OA) publishing as a transparent, inclusive, and accessible way of sharing their work and making their scholarly contribution visible to the world. The recipe is specifically created for academic libraries that are reconsidering their OA programs and offers guidance on showcasing students' research achievements through institutional repositories.

LEARNING OUTCOMES

By following this recipe, readers will be able to:

- promote undergraduate research and communicate it to a broader audience;
- demonstrate the value of library digital publishing services;
- set up the process for curation and preservation of student research posters;
- raise students' awareness of their role as information creators and participants in the scholarly conversation; and
- educate students on OA practices and the benefits of research dissemination.

NUMBER SERVED

The number of participants can vary. In our case, we had around fifty submissions; but ideally, all student researchers would deposit their digital research works to the institutional repository (IR).

COOKING TIME

Preparation starts as early as three months before the student research symposium event to allow time to assemble all the necessary ingredients and prep them for cooking.

DIETARY GUIDELINES

Institutional repositories, designed to store, preserve, and disseminate scholarly works, are often reserved for faculty intellectual outputs. This recipe recommends an update to the dietary guidelines by encouraging undergraduate students to deposit their research in the IR, allowing them to not only preserve but also showcase their scholarly outputs, while educating students about open science principles and practices. This recipe also reinforces the ACRL *Framework for Information Literacy for Higher Education*, particularly Information Creation as a Process, Information Has Value, and Scholarship as Conversation.

INGREDIENTS AND EQUIPMENT

Here is a list of ingredients and equipment

required for this recipe:

- original research conducted by an undergraduate student and guided by a faculty
- a collaborative team that consists of faculty, librarians, an IR specialist, and technical support staff
- sample templates for student research symposium participants to build their posters
- workshops delivered by faculty members to students engaged in research
- final version of the students' research posters approved by faculty advisors
- an IR to host participants' posters
- an IR submission form that collects metadata on posters and records students' consent to deposit their works

PREPARATION

Unlike traditional kitchens where "too many cooks spoil the broth," for this recipe, students, faculty advisors, librarians, and technical support staff collaborate to bring this dish to the table.

First month: while students are still working on their drafts, faculty and librarians arrange to deliver a series of workshops, including a library session highlighting the importance of the literature review and proper citations, to all student participants.

Second month: students submit their final drafts to appointed faculty members who review and provide feedback.

Third month: in the final stage leading to the symposium, students work alongside their faculty advisors on revising their drafts based on the feedback they received, submit their final posters, and prepare for their live presentations.

This preparation process culminates in the event where students present their research. At the MotM, students introduce their posters to a committee of judges from the university, as well as other local educational institutions, and compete for prizes.

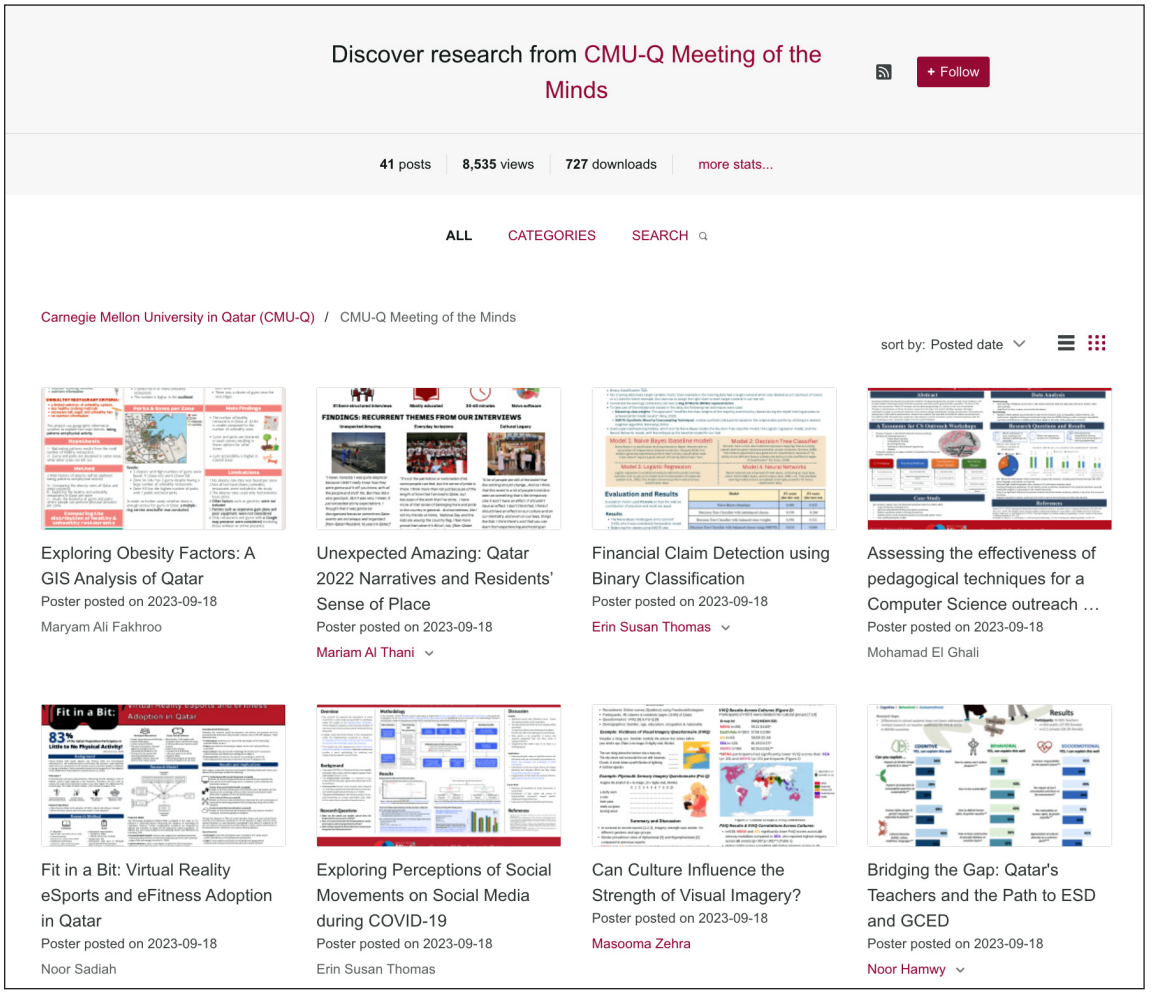

Figure 1. Example of the IR poster entries and corresponding metrics

COOKING METHOD

Once students finalize their posters based on the faculty feedback, they are asked to fill in a form and indicate whether they are interested in depositing their work to the IR. Those who opt in complete a supplementary section of the form to provide additional information, including the subject category, project keywords, and type of Creative Commons (CC) licenses they want for their work. They digitally sign an agreement to grant CMU the permission to reproduce and distribute their research.

The end of the symposium signals the beginning of the cooking time, when librarians put on their toques and collaborate with the IR specialist to:

- create a repository group to host the collection of posters;
- upload the posters to the IR with required metadata for visibility; and
- ensure the proper display of the posters and linked data.

Once the posters are uploaded to the IR, the dish can be considered officially ready to be served. Send an email to students to inform them about their posters' location and how to find their unique doi to add to their curriculum vitae or e-portfolio. Since many repositories' entries are indexed by major databases and search engines like Google Scholar, students' work gains visibility from day one. Students can track the potential impact of their work—and watch open science principles in action—through statistics on the number of viewings, downloads, and citing of posters (see figure 1).

CHEF'S NOTES

For the recipe to receive a five-star rating and be savored by faculty and students, we recommend:

1. extending the prep time by at least a couple of months to ensure that all the ingredients are handy and the cooking is not rushed;
2. adding some seasoning in the form of an additional workshop for students to practice communicating their research to the public;
3. periodically checking the cooking temperature during the preparation; the deposit of undergraduate research posters could take more time than expected, so it is important to verify that the stove is on and continuously cooking; and
4. actively promoting the value of IR to students so that nothing goes to waste in the cooking process. For the first iteration of the recipe, the majority of MotM participants decided to deposit their works (a total of forty-one out of fifty-three posters).

ADDITIONAL RESOURCES

Association of College and Research Librarians. (2015). *Framework for Information Literacy for Higher Education*. American Library Association. http://www.ala.org/acrl/standards/ilframework

Carnegie Mellon University. (2023). *CMU-Q Meeting of the Minds.* KiltHub. https://kilthub.cmu.edu/CMU-Q_MOTM

More Cooks in the Kitchen:

Hosting a University-Wide Celebration of Faculty Scholarship

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NUTRITION INFORMATION

This recipe guides chefs through the process of creating a collaborative celebration of faculty scholarship (CFS) that promotes open access (OA) publishing and collaboration with the libraries. Academic institutions are often siloed, leading to redundancies and missed opportunities for collaboration. Academic libraries can address this by hosting an annual celebration of faculty publications and scholarly pursuits that is open to all faculty, staff, and students. The event provides attendees with an opportunity to discover research outside of their departments, mingle with peers, and learn about library resources that support OA publishing.

By promoting opportunities for OA publishing, your institution may be able to share more published scholarly articles with the community collaborators who helped to create them. Providing access for those non-affiliated collaborators is a valuable act of information justice that supports equity. Additionally, sharing OA publications with these partners strengthens the reciprocal nature of the relationships, increasing the possibility of new or renewed collaborations. If you're a chef who likes to feed your community, this is a great recipe for you.

LEARNING OUTCOMES

This dish will help chefs and attendees:

- learn more about Open Access (OA) publishing at their institution;
- increase awareness of opportunities for OA publishing;
- learn about OA resources that the libraries provide and/or support;
- identify potential collaborators within other academic disciplines;
- view the libraries as potential publishing collaborators;
- see beyond their disciplinary silos; and
- gain exposure to the library's staff, facilities, and resources.

NUMBER SERVED

One three-hour event serves over a hundred attendees. Cooks can adjust the serving size according to their needs and resources (e.g. physical space, time, and labor).

COOKING TIME

Preparation time includes two to three months to conduct outreach, gather and/or purchase faculty publications, promote the event, and plan and order refreshments.

If chefs have early access to the event space, they can stage the room in advance. Otherwise, the space can be set up two to four hours before the event. The event itself will last two to three hours.

DIETARY GUIDELINES

This recipe is built on two frames from the ACRL *Framework for Information Literacy in Higher Education*: Scholarship as Conversation and Information Creation as a Process. The event will be a mixing pot of scholars from across departments, colleges and/or disciplines, and academic levels. Attendees can discover and inquire about each other's works, develop relationships, and enrich their own scholarship with diverse perspectives. Additionally, this event is a celebration of scholarship in both traditional and emerging forms. Students and faculty will be exposed to traditionally published scholarly articles, OA articles, conference posters, recorded proceedings, podcasts, art, and more. It may broaden their understanding of what scholarship can look like and encourage them to consider the value of different forms of creation and dissemination.

This recipe also provides libraries with an opportunity to increase open access publishing and readership at their institutions. Faculty who were unaware of library resources to support OA publishing or were skeptical about the quality of OA publications will

hopefully leave the event with new understanding. This is an important step in the process of supporting equity and information justice. Due to paywalls and distribution restrictions, many unaffiliated community collaborators will never be able to access final publications for scholarly works to which they contributed. Open access publishing is one way to equitably share scholarly works with the communities who made them possible.

INGREDIENTS AND EQUIPMENT

- four or fewer library staff members, ideally including staff from acquisitions and/or interlibrary loan (ILL)
- faculty publications (e.g., articles, books, book chapters, artwork, recorded presentations)
- catering/refreshments
- open access stickers or other labels to label OA publications and/or those with waived Article Processing Charges (APCs) through the libraries' transformative agreements
- brochures and/or flyers about open access and feature library services, liaison business cards, and/or QR codes for any online versions of these
- collaborative project/data management tool with a form function (e.g., Airtable) to collect and track faculty submissions
- printer
- tables—long tables for buffet trays and bar; high-top tables for attendees—and optional linens and centerpieces
- book stands
- binding spines for articles
- photo or business card display stands

PREPARATION

1. Gather a small core team of around four librarians (can be done with fewer if necessary) who will manage the process. Including at least one librarian from acquisitions and/or ILL streamlines the process of purchasing and/or gathering resources.

Outreach and Solicitation

1. Create a form, using software like Airtable that will compile data and enable easy tracking of acquisitions, printing, etc., that faculty can use to submit their scholarship (see table 1).
2. At least two months prior to the event, subject specialists and/or liaison librarians should encourage their faculty to submit their work for inclusion.
3. Chefs can search in institutional repositories (e.g., Digital Commons) to identify publications for more targeted outreach.
4. Ask university administration (e.g., president, provost) and library administration (e.g., dean, director) to give brief remarks about the libraries and/or faculty scholarship.

Catering and Facilities

1. Estimate attendance, explore catering options, and secure budget approval. For budget-friendly cooking, replace catering with store-bought snacks.

Table 1. *Faculty Submission Form*

Submission Fields	Required Response	Entry Type
Citation or Description of 1 Item to be Displayed	Yes	Text
Resource Link	No	Text
Date of Publication	No	Date format (Mmddyyyy)
Author FirstName	Yes	Text
Author LastName	Yes	Text
Author Credentials	Yes	Text
Author Department and/or School	Yes	Text
Author Photo	No	Upload
Names of Student Collaborators	No	Text
Questions and/or Special Display Requests	No	Text
CV and/or Attachments	No	Upload
Attach File	No	Upload
Consent to be Featured on the Library's Social Media?	No	Checkbox

2. Identify and reserve a campus space. Ideally this will be in or near the libraries.

Collection

1. Begin to collect materials on a rolling basis. Track the status of these items throughout the process and note whether they are purchased, printed, on hold, etc.
2. Articles can be downloaded and/or requested from ILL; books can be purchased, located in the stacks/storage, and or requested from ILL; book chapters can be obtained through acquisition of the book or by requesting the chapter from ILL; recorded presentations, artwork, and other nonprint scholarship should be acquired according to the desired method for display.
3. All articles and book chapters should be printed and bound with binder spines/clips. Consider adding zest with a color-printed cover sheet of the journal or book cover.
4. Faculty pictures should be printed in color. If no picture was submitted, print a small name card. The name card and faculty photo should both list the author's name and school/department.

Advertisement

1. One or two chefs should lead promotional efforts, including
    a. social media posts,
    b. physical flyers posted across campus,
    c. A library website banner and/or event listing, and
    d. targeted outreach to diverse members of the campus community.
2. Faculty members can consent on the submission form to social media coverage of their scholarship. Posts should provide event details and tag relevant accounts (e.g., Biology Department, Student Government Association, Nursing Student Alliance) who would be particularly interested in the publication and/or faculty member. This will increase the likelihood of the post being shared and reposted to reach a wider audience.

COOKING METHOD

The morning of the event (or the day before, if possible), you can move your prepared ingredients into the kitchen.

- Using the list on Airtable or other software, ensure that all materials are accounted for. Pair name cards and/or pictures with their matching item to make sure that no more printing is required.
- Confirm with the caterers about their required table and kitchen set-up. It's likely that they will require at least two large folding tables for the food and an additional table for drinks. Place these in accessible areas.
- Arrange tables with sufficient space for attendees to walk between tables. This recipe is designed to be social and dynamic; encourage movement by providing high-tops rather than sit-down tables. These can be placed along the edges of the room. For accessibility purposes, chefs should ensure that there are at least a few chairs along the periphery of the room.
- Arrange scholarly work with a variety of disciplines and formats represented at each table. This will provide visual interest and encourage faculty to view scholarship outside of their departments.
- If possible, cover display tables with linens, and place centerpieces on each table.
- The open access brochures and other educational handouts can be placed on a table by the main entrance. Ensure that it does not violate safety codes.

The hard work is done now. Mingle with the guests, enjoy the food, and take your chef's hat off.

Stretch this meal further by continuing to post on social media about faculty scholarship over the next weeks or months.

CHEF'S NOTES

The first time you cook this dish will be the hardest. After you've set up the submission forms and gone through the preparation process once, each subsequent dish will be quicker and easier to make.

Section 5.

Collaborations and Partnerships

Delicious Synergy:

Using DMPs to Build Library Engagement With Data-Intensive Student Programs

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NUTRITION INFORMATION

Libraries at research universities want to engage with faculty and departments to address the curation of research data and the advancement of reproducible science practices and FAIR data, but finding opportunities to do so can be challenging. This recipe offers a structured approach to developing a deep and lasting engagement with a department. The essential prerequisite for this approach is that the department in question have a data-intensive student program such as a final project or capstone. By adding a data management plan (DMP) requirement to the program and then building on that, the library can form a delicious synergy with the department.

LEARNING OUTCOMES

Readers of this recipe will be able to form an engagement between the library and a campus department that provides structured opportunities for the library to consult, instruct, and otherwise support faculty and students on data management and open science topics.

NUMBER SERVED

Our experience is that more than one research data librarian is required to handle a cohort of even thirty students, but two to three librarians can handle up to a hundred students.

INGREDIENTS AND EQUIPMENT

- An academic department that requires students to complete a final project or capstone that involves acquiring, analyzing, generating, and possibly archiving diverse datasets.
- Library staff who have expertise in research data management and in open, reproducible science principles and practices.

PREPARATION

The first step is to add a data management plan (DMP) requirement to the department's curriculum. (See the Additional Resources section below for a complete example of curricular DMP requirement text.) It goes without saying that this involves the consent and even active participation of the department. Explain the benefits of adding a DMP requirement, which include:

- Students gain experience in data management planning, which will be required if they ever apply for grant funding in their future careers.
- Faculty advisors, even if they are familiar with research data management recommendations, typically only have time to focus on the topics and substance of student projects, but adding a DMP requirement ensures that students will receive critical data management instruction from the library.
- The students' work will be better organized; their data will be more reusable and their work will be more reproducible.
- A DMP requirement will facilitate the construction and maintenance of an archive of student projects and associated data.

Once a DMP requirement is in place, the library is poised to offer additional services and resources. For example, DMPs provide an opportunity for the library to deliver student workshops on open science principles and data management practices. The library can also consult with students on their specific projects and assist them in curating and publishing their data. Through these efforts, the department will gain familiarity with library staff and services, which can lead to further opportunities for collaboration on topics like data repository solutions and open access publication opportunities. The library can also play a role in assessing student DMPs, just as grant application DMPs are assessed by funders. Assessment of DMPs also provides the opportunity to educate faculty on data management requirements and best practices. (See table 1 for a sample academic calendar that highlights potential library interaction points.)

Table 1. *Timeline of a Two-year Capstone Project. Interactions with the library team are highlighted in underlined text with a triangle bullet*

Semester	Student activity
One	○ Develop work plan in consultation with faculty advisors
	▶ Attend library workshop on data management planning
	○ Incorporate feedback from faculty advisors
	▶ Incorporate feedback from library DMP assessment with optional library consultation
	○ Host work plan review meeting with faculty advisors, clients if any, and external advisors
	○ Submit final work plan
Two	○ Host review meeting with faculty advisors, clients if any, and external advisors
	▶ Attend library workshop on data management
	○ Submit outline of final report
Three	○ Draft background, methods, and preliminary results sections of final report
	○ Receive faculty review of project
	○ Complete draft of final report
Four	○ Draft executive summary
	▶ Consult with the library on data/metadata and code deposit requirements and procedures
	○ Deliver final presentation
	▶ Submit data, metadata, and code to archive and go through the curation process
	○ Submit self/peer evaluation to faculty advisors and program coordinator
	○ Submit faculty advisor evaluations to program coordinator

COOKING METHOD

As students create their DMPs and then work to implement them, the library can offer workshops on research data management, both planning and implementation, and on general open science and reproducibility principles.

We suggest offering two workshops:

- The first workshop is designed to help students develop their data management plan as part of their project proposal. Agenda topics include:
  - open science and its importance
  - data lifecycle
  - introduction to DMPs
  - developing your DMP
  - FAIR principles as a framework for planning data management
  - CARE principles for sensitive data management
  - demonstration of the DMPTool (https://dmptool.org/)
  - how to use your DMP as a living document
- The second workshop, which should take place after students have begun to work on their projects in earnest, focuses on data management and preservation. Agenda topics include:
  - reproducibility and analytical workflows and how scripts can help
  - data management tips
    - tracking data sources
    - keeping a copy of the raw data
    - making work portable (project folder structure and naming conventions)
  - how to document
    - README files
    - code commenting
    - metadata
  - keeping data safe
    - backup strategies
    - file permissions
  - data preservation
    - what to preserve?
    - preparing files
    - preparing README files
    - submission and curation process

If the library offers an institutional repository, as students near the archiving phase of their project, they can reach out to library data curators to consult on how to best develop the necessary documentation and how to select which datasets to reference/cite and which to include in the archive. This early consultation can reduce back-and-forth communication during the curation step and provides its own teaching opportunity.

As a complement to the workshops, consider baking all the necessary information into a website that students can reference as they work on their projects. We recommend organizing the materials according to the phases of the research data life cycle—planning, man-

aging, and preserving. (For an example, see UC Santa Barbara's Project Data Management website, https://ucsb-library-research-data-services.github.io/project-data-management/.)

CHEF'S NOTES

Program-specific DMP requirements and templates can be crafted and added to the DMPTool (https://dmptool.org/) to streamline the DMP writing process while connecting students to campus-specific guidance and local resources. This will also simplify the feedback process since students can use the tool to request help and incorporate feedback.

Library assistance with the assessment of DMPs will very likely be coincident with department evaluation of student project proposals, and will thus require that the library have the resources to perform such work at a specific point and by a certain deadline in the academic year. The same is true if the library assists with deposit of student data: the library must be able to complete curation of data deposits before students graduate.

ADDITIONAL RESOURCES

The following is an example of DMP requirement text that can be inserted into a department curriculum. This example happens to include a data deposit requirement. Notice how the text includes the form the DMP should take, the rationale for its requirement, and advice and examples.

Data, metadata, and associated code emerging from the project will be archived for public use. The only exception is for data restricted by a non-disclosure agreement or a license. For both public and restricted data, the group's work plan must include a Data Management Plan (DMP). The DMP (one to two pages) describes how research data will be managed during the project and, if appropriate, made available to others after completion. There are six major topics to discuss in the DMP:

1. **Describing the research data.** What data are needed? Are such data available? When and how will the data be acquired? Provide a description of the data the group will collect or reuse, including the file types, data set size, the number of expected files or sets, content, and source of the data (creator and method of collection).
2. **Data standards.** Are there any standard formats in the specific research field for managing or disseminating the data sets that have been identified? Who in the group will have responsibility for ensuring that data standards are properly applied and data are properly formatted?
3. **Metadata** is documentation that helps make data sets reusable. Think about what details (metadata) someone would need in order to be able to understand and use your data. For example, perhaps a README.txt file is necessary to explain variables, the structure of the files, etc. In addition, metadata should follow disciplinary standards, including ontologies and vocabularies. If applicable, describe how the group's model construction, scripts, and/or workflows will be documented.
4. **Data sharing and access.** The data may have significant value for other researchers beyond this project, and sharing your data is part of your responsibility as members of the scientific community. Specify the extent to which data can be reused, including any access limitations. List any proprietary software that might be needed to read the files. If there is data that is not appropriate for sharing due to confidentiality, NDA, or disclosure risk, then describe that here.
5. **Intellectual property and reuse.** If data were collected from a client organization or other external distributor or source, does the group have the right to redistribute it? If so, are there any restrictions on redistribution? If the group created its data files, will it assign a Creative Commons license to its data?
6. **Data archiving and preservation.** Throughout the project, the group may produce a large number of files. At the end of the project, groups must submit data used in the project (except data protected by non-disclosure agreements) and associated metadata for archiving. Not all data needs to be saved. If another researcher wanted to replicate the group's work or reuse the group's data, what data and documentation would be required for them to do so? Where will the data and metadata be stored after the project is completed? Is there a subject-specific and/or open-access repository that is appropriate for the data? If students need assistance in evaluating repositories, they should contact the library for consultation.

Infusing Open Science Ingredients into Evidence Synthesis to Create a Rich Medley for Researcher Support

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NUTRITION INFORMATION

Evidence synthesis refers to a collection of related research methodologies, including systematic reviews, scoping reviews, systematic maps, and meta-analysis, that seek to comprehensively find, synthesize, and report the existing knowledge for a given topic or research question (Grant & Booth, 2009). A rigorous and high-quality evidence synthesis project requires advanced knowledge of information sources, search strategies, and research data management. Since many of these skills are the bread and butter of library chefs, it is fairly common for academic libraries to have services dedicated to supporting evidence synthesis projects.

Evidence synthesis and open science share many key ingredients, like an emphasis on transparency and reproducibility, and the term "open synthesis" has been coined to describe the further opening up of evidence synthesis methodologies (Haddaway, 2018). With the advent of open science services in academic libraries, there is a new opportunity for open science instruction and guidance to be authentically baked into evidence synthesis services. This recipe is fusion cuisine, cooking up evidence synthesis services through an open science lens.

LEARNING OUTCOMES

Library chefs that integrate open science and evidence synthesis will be able to:

- describe the shared principles and practices of open science and evidence synthesis;
- recognize opportunities in evidence synthesis support or instruction to promote open science practices and principles; and
- identify and use openly available tools that facilitate evidence synthesis work and also support the open science principles of transparency, reproducibility, collaboration, and open source.

NUMBER SERVED

An evidence synthesis project is highly collaborative and requires a team, typically comprised of at least two researchers with subject expertise and an information specialist with knowledge of evidence synthesis methodology. Too many cooks in the kitchen? Not in this case! Evidence synthesis projects will benefit from larger teams, which may include undergraduates, graduate students, and practitioners. Students make great sous chefs and can help shorten the cooking time of an evidence synthesis project.

The number of evidence synthesis projects that a library supports at any given time can vary and will depend on interest from researchers on campus and the capacity of the evidence synthesis team. You can increase capacity by offering to provide guidance in a more limited role as a project consultant.

COOKING TIME

An evidence synthesis project typically takes at least six months, but the length will vary depending on the type of project. A systematic review, for example, is often a multiyear project. Teams will often meet on a regular basis during the project, but some team members might only be involved in certain phases. Incorporating open science elements, such as writing a protocol, preregistering the study, and sharing the underlying data, could add cooking time, but this extra time spent in the kitchen will save time later, either for the original project team or for others who want to reproduce or update the study. By adding open science practices, you can slow roast an evidence synthesis project to perfection. An evidence synthesis project presents the

perfect opportunity to demonstrate the idea that open science practices are like a soufflé: high effort but high reward. And with a bit of practice, it gets easier.

DIETARY GUIDELINES

Open science is often taught as a series of abstract principles and practices. Academic librarians might not have many opportunities to teach open science in an authentic research setting, but the only way to learn how to cook is to actually do it. By including open science into an evidence synthesis project, librarians have an opportunity to teach open science in an authentic research setting and incorporate lessons about the benefits of open science throughout a long-term collaboration.

One of the most exciting opportunities of teaching open science in a "learn by doing" manner in the context of an evidence synthesis project is that a researcher might go on to apply the same practices to their other primary research projects.

INGREDIENTS AND EQUIPMENT

There are several pieces of equipment that can help with an evidence synthesis recipe; choosing open source options will reinforce open science practices and principles.

- Subscription bibliographic databases can be used in conjunction with free resources, such as Google Scholar, Lens.org, or OpenAlex for finding studies and evidence.
- Citation management software is used for managing references at the various stages of the project. Zotero is an open source option.
- Screening tools aid in the screening, data extraction, and quality assessment phases of the project. Examples include Rayyan, Covidence, and Sysrev. Most screening platforms have free and paid versions.
- The Systematic Review Accelerator (SRA) is a suite of free tools for facilitating the evidence synthesis research process.
- Open Science Framework, an open source web application, can be used for preregistration of research protocols and project management.
- OpenRefine, Python, R, or SQL, open source scripting languages and tools, can be used to programmatically clean, organize, and analyze the data. The Carpentries provides open source lesson plans on using these tools.
- A public repository will be needed for sharing the research data. Researchers and students can be introduced to the institutional repository through this project.

PREPARATION

A successful fusion of open science and evidence synthesis requires considerable preparation that starts with assembling a team with the right expertise and skill set. This includes at least two people knowledgeable in the domain or topic of the review project and experts in information management and evidence synthesis methods. If the desired end product includes a side of meta-analysis, a statistician may also be required. Students, graduate or undergraduate, can also play key roles in supporting the review if given proper training and support.

Once the team is assembled and planning begins, it can be useful to think in advance about the publishing venue for the final review—this can help determine which reporting standards need to be considered, allowing for better documentation planning.

At this stage, conversations with the team about software and platform options for managing the review process, preregistering protocols, and sharing outputs of the review can also be helpful. This presents an opportunity to discuss open tools like Open Science Framework or Sysrev, a platform for managing evidence synthesis steps and publicly sharing screening and data extraction data.

COOKING METHODS

Evidence synthesis is a multistep process, but standard practices provide a clear recipe for achieving a successful outcome. At each step, open science principles can be folded in for a more transparent, reproducible, and accessible final dish (see figure 1).

Step 1: Planning is the meat and potatoes of any good evidence synthesis project. In this phase, teams refine their research questions, develop a protocol for every review stage, and make a priori decisions about eligibility of studies for inclusion in the review, which

Evidence Synthesis Step	Open Science Lessons	Open Science Tools
Planning	• Preregistered protocols for transparency and reproducibility	• OSFRegistries
Searching	• Value of open access publishing for comprehensive searching	• Lens • OpenAlex
Screening	• Value of open access publishing for full-text retrieval	• Sysrev
Data Extraction	• Value of open data for comprehensive data extraction	• Sysrev
Synthesis	• Open source tools for reproducible data analysis • Cleaning data to maximize reuse	• Python and Jupyter Notebooks • R and RStudio • SQL • OpenRefine
Publishing	• Value of preprint and open access publishing • Repositories for public access of data and other research products • Metadata documentation in READMEs to maximize reuse	• Preprint servers • Open Access journals • Repositories

Figure 1. Open science in evidence synthesis.

helps avoid cherry-picking, a common problem of traditional literature reviews.

Open science is infused at this planning stage through preregistration of protocols in a public repository. The protocol can serve as a roadmap for the project and improves transparency and reproducibility. An evidence synthesis project might be a researcher's first exposure to preregistration, as it's not a common practice in all disciplines.

Step 2: Teams search in both subscription databases and free resources to find studies that will be screened for eligibility. This presents an opportunity for discussing the hidden biases of search algorithms and the openness, or lack thereof, of the scholarly record. Teams will thoroughly document searches, which supports transparency and reproducibility.

Step 3: Teams screen studies to determine eligibility. Screening software can facilitate documentation of this process, and screening decisions can be shared as an associated dataset, in line with open data sharing practices.

In this stage of the project, the team will retrieve the full text of included studies. A fairly straightforward tutorial on how to use interlibrary loan to retrieve full-text PDFs can be reframed as a lesson on the value of open access publishing. Any irretrievable records will help reinforce the lesson.

Step 4: The team extracts information and data from included studies, again documenting decisions and conflicts amongst independent data extractors. The lack of shared data in many disciplines becomes apparent when extracting data from included studies, which reinforces the value of open data.

Step 5: The team synthesizes or summarizes data from the including studies. Depending on the particular flavor of evidence synthesis desired, this may or may not involve critical appraisal, meta-analysis or other forms of synthesis or data presentation.

Open source scripting tools and languages, such as Python, R, and SQL, should be used whenever possible for data analysis. Jupyter Notebooks, a literate programming tool for coding in Python, can be used to improve the interpretability of the code and facilitate its reuse. Proprietary software often seems easier or more convenient but other researchers might not have access to it (or it might cease to exist in the future), thus limiting the reuse of the work.

One of the biggest limitations of data reuse is that the data are messy. An evidence synthesis project provides an opportunity to teach researchers how to clean data with the open source software, OpenRefine, and in turn make it more reusable. Once again, you can provide the lesson of a little extra time in the kitchen saving time later on.

Step 6: Finally, the team writes up and publishes the evidence synthesis project. Authors should adhere to reporting guidelines and standards as well as describing deviations from the protocol for maximum transparency.

The team can deposit other products of the research, such as screening data or extracted data, on public repositories with READMEs to maximize their reproducibility and reuse. The team can consider publishing their work on a preprint server or in an open access journal to maximize access and discovery.

CHEF'S NOTES

A key characteristic of evidence synthesis methodologies is that they include standardized reporting guidelines that improve the transparency and reproducibility of the study. Since evidence synthesis is more commonly used in specific disciplines, such as medicine, there may not be clear guidelines for reporting synthesis studies in other fields. The reporting guidelines might have to be adapted for use in nontraditional disciplines; teams should take care to ensure that the study is as transparent and reproducible as possible.

Similarly, the application of automation to evidence synthesis is a new and evolving element of the methodology. Automation, including machine learning applications and large language models, can be applied at different stages to facilitate the process. While this can lead to valuable conversations about how such tools impact transparency and bias, standards for how to use automation in evidence synthesis projects do not exist yet.

Anyone embarking on an evidence synthesis project and aiming to meet the requirements for a rigorous and transparent approach should be prepared for a long-term commitment. These projects require many months, and in some cases years, of simmering to achieve a high-quality end product. Library chefs should be aware that these projects often get put on the back burner as they compete with the many priorities of a busy researcher, but we have found that commitment, good planning, and reasonable timelines and expectations can help get these projects to the dinner table.

ADDITIONAL RESOURCES

Learning and skilling up:

- Data Carpentry, https://datacarpentry.org/lessons/
- Software Carpentry, https://software-carpentry.org/lessons/

Evidence synthesis tools:

- Covidence, https://www.covidence.org/
- Rayyan, https://www.rayyan.ai/
- Sysrev, https://www.sysrev.com/
- Systematic Review Accelerator (SRA), https://sr-accelerator.com/#/

Free scholarly information discovery tools:

- Google Scholar, https://scholar.google.com
- Lens, https://www.lens.org/
- OpenAlex, https://openalex.org/

Open source software tools:

- Jupyter Notebooks, https://jupyter.org/
- OpenRefine, https://openrefine.org/
- R, https://www.r-project.org/
- RStudio, https://posit.co/download/rstudio-desktop/
- Python, https://www.python.org/
- SQLite, https://www.sqlite.org/

Information management and collaboration tools:

- Open Science Framework, https://osf.io/
- Zotero, https://www.zotero.org/

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Haddaway, N. R. (2018). Open Synthesis: On the need for evidence synthesis to embrace Open Science. Environmental Evidence, 7(1), 26. https://doi.org/10.1186/s13750-018-0140-4

Bibliometric Fusion:

An Open Science Collaborative Project on Research Collaboration Network Mapping

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NUTRITION INFORMATION

This recipe is crafted for academic libraries interested in fostering collaborations with researchers, administrators, or students to leverage bibliometric data and methods for the purpose of building, analyzing, and understanding research collaborations, all while upholding a commitment to open science principles.

In a research collaboration network, nodes represent authors, and links among them signify coauthor relationships. Collaboration networks facilitate the identification of key contributors and influencers. Mapping collaboration networks aids in recognizing knowledge hubs and nodes that facilitate the sharing of expertise and resources. Understanding how collaborators are connected can reveal potential areas for innovation. When presented in an accessible manner, such as an interactive network map, this dish might provide insights for diverse stakeholders: prospective students seeking academic institutions, programs, and advisors; researchers seeking potential collaborators; administrators seeking insights into collaborations among institutions and individuals; and patients in search of expertise within specific physician subspecialties (see figure 1), among others.

In this collaboration, academic librarians from diverse subspecialties within information and library science serve as experts in bibliographic databases, scholarly communication, data handling, analytics, visualization, and data management. They provide crucial guidance and support for promoting open science practices. With their support, this collaboration model effectively addresses the challenges and resource limitations faced by researchers, administrators, and students in other fields when planning and implementing a project of this nature.

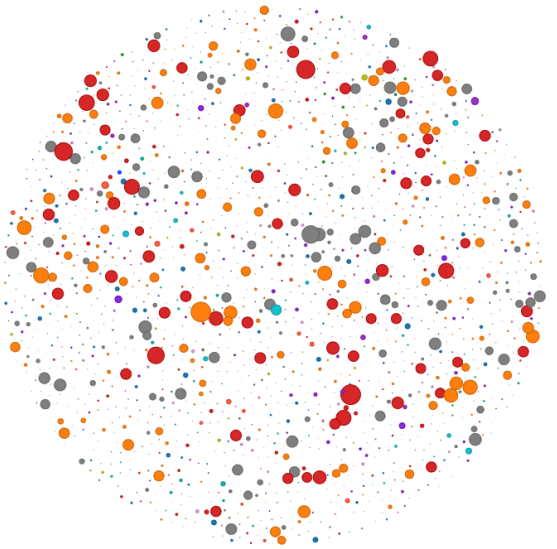

Figure 1. In this screenshot of a sample collaboration network depicting clinician researchers in a medical field in the United States, node size indicates Eigenvector centrality, and node color indicates community.

Drawing inspiration from the concept of fusion cuisine, this approach seamlessly integrates diverse data sources and tools, adapting them to meet customized analytical needs, constructing a holistic portrait of research collaboration patterns, incorporating domain-specific norms for comprehensive understanding, and presenting these findings in an innovative way.

LEARNING OUTCOMES

After reading this recipe, cooks will be able to:

- identify the requisite resources and collaborators necessary for an open science project focused on mapping research collaboration networks;
- customize and apply the workflows to suit their specific requirements, enabling them to implement similar projects aimed at mapping collaboration networks; and
- evaluate and determine optimal approaches at each stage.

NUMBER SERVED

Aligning with the principles of open science, this recipe is tailored for expansive tasting events within and beyond the academic community rather than private dinner parties.

COOKING TIME

Depending on the project's scope and the level of collaboration among contributors, the preparation of this dish may span from one to several months.

INGREDIENTS AND EQUIPMENT

The list below outlines the essential ingredients and equipment required for preparing this recipe, but adaptability and creativity are key. Cooks are encouraged to tailor their approach based on their unique goals and constraints.

- in-depth understanding of academic research and scholarly publishing
- knowledge of persistent identifiers (PIDs) referring to scholarly works, contributors, and organizations
- capability to query and collect data from bibliographic databases indexing scholarly publications
- permission to utilize the databases and data for research purposes
- skills and tools for effective data cleaning and wrangling
- proficiency in network analysis and visualization, supported by appropriate tools
- code and data sharing platforms
- reliable web hosting infrastructure

PREPARATION

1. **Delineate project scope and research aims.** To determine the project scope, it is critical to identify the authors of interest. Depending on whether or not your project aims to focus on a definitive list of authors, the workflow differs (see figure 2).

One workflow involves starting with a definitive list of authors and then retrieving publication information. Author lists might be generated from specific institutions, departments, scholarly societies, laureates of awards, etc. Alternatively, cooks can start with a list of publications associated with a topic of interest, journal, or a conference and then extracting author information. The Cooking Method section will illustrate the former approach to creating an interactive collaboration network of researchers based on Scopus data.

2. **Establish collaboration and define team roles.** For this fusion dish, it is critical to have a team of cooks with diverse backgrounds. A possible team combina-

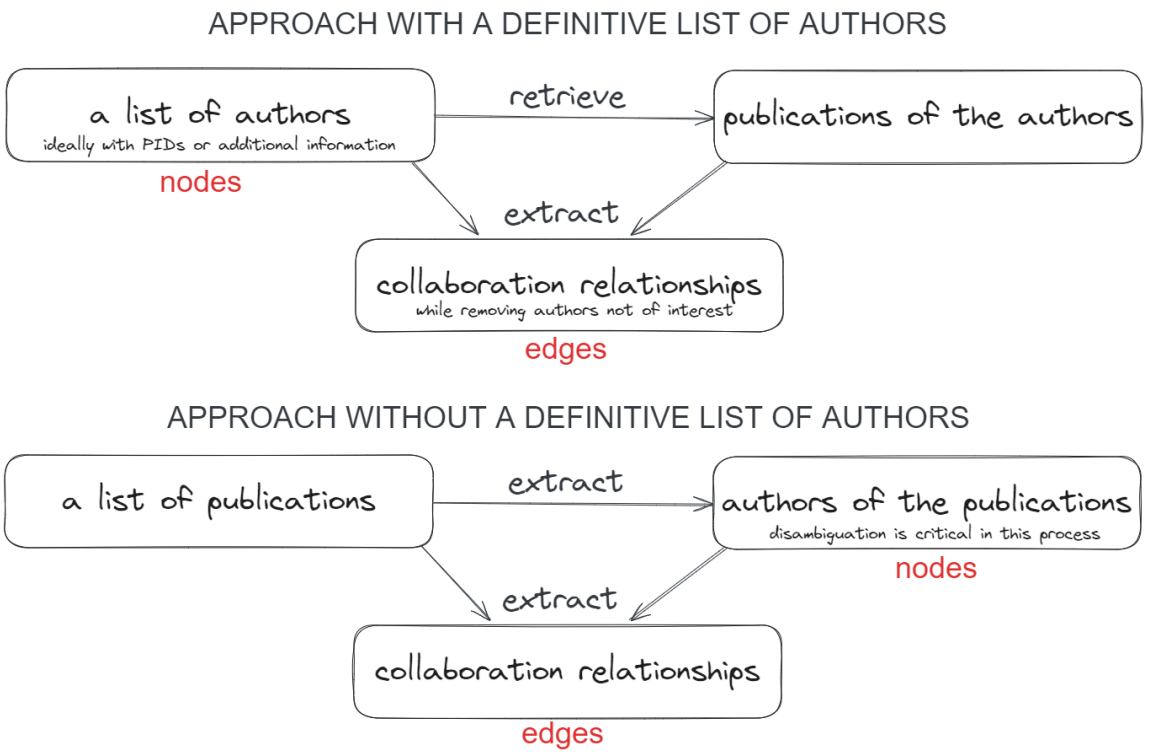

Figure 2. Two workflows depending on the availability of a definitive list of authors.

tion includes a scholarly communication librarian, a data science librarian, a subject librarian, a researcher, and a research assistant. It is recommended to have at least one domain expert that understands discipline-specific scholarly norms, such as common publication types, venues, collaboration and contributorship practices. Cooks will serve different roles. Some cooks might serve as consultants.

3. **Review the ingredients and equipment guideline above, and identify what best serves your project scope and research aims.** Following are the ingredients and equipment for the approach outlined in this recipe.
   - Databases: ROR, Scopus (including the Scopus Search API and the Author Search API)
   - PIDs: ROR ID, Scopus EID, DOI, PubMed PMID, Scopus Author ID
   - Jupyter Notebook and Python:
     - libraries for data collection: requests, json, pandas, NumPy, FuzzyWuzzy
     - libraries for network construction, analysis, and visualization: NetworkX, Pyvis, Matplotlib
   - Github

If you are missing any ingredients or equipment, refer to the Additional Resources section for preparation guidance.

COOKING METHOD

1. **Determine sampling and data collection strategies.** Consider criteria such as field, affiliation, time window, geographic location, etc.

2. **Data collection, cleaning, and processing.** The goal is to prepare a node list (authors) and an edge list (collaboration relationships). Cooks are encouraged to tailor these steps based on their equipment and ingredients, ideally automating this process as much as possible.

Creating a node list: As illustrated in figure 1, when retrieving publications for a list of authors, the ideal scenario involves having PIDs for all authors. However, this is often not the case in reality. Some other information might help. For instance, if affiliation information is available for the authors, use their institutions' ROR ID as an additional restriction when matching author names to Scopus Author IDs. This will help eliminate the majority of false positives (authors with the same names at other institutions). Due to the potential lack of uniqueness in names even within institutions, manual review remains necessary. If PIDs are available, skip this step and use the PIDs to collect additional data of interest, such as citation counts, h-index, etc.

Creating an edge list*:* Query the Scopus Search API and retrieve metadata for publications associated with the Scopus Author IDs collected earlier. For each publication, you will need, at minimum, the publication's PIDs (Scopus EID, DOI, and PubMed PMID) as aids in subsequent cleaning and de-duplicating processes. Additionally, collect the Scopus Author IDs of all authors for these publications. Compare these Author IDs with those in the predefined list and exclude authors not of interest. Iterate through the list of publications and extract collaboration relationships and frequencies for all authors. This list of collaboration relationships constitutes the edge list.

Note: plan data collection accordingly depending on the API rate limits.

3. **Network construction**. Take the node and edge lists and construct the network using the NetworkX library. Cooks who use Python can refer to the Jupyter Notebook (see Additional Resources section below) for step-by-step guidance.

4. **Data analysis and visualization.** Use NetworkX to calculate network statistics.
   - Degree centrality indicates the number of collaborative relationships an author has with others.
   - Betweenness centrality measures how effectively an author serves as a bridging role and connects others who might not otherwise be linked.
   - Eigenvector centrality rises when an author collaborates with well-connected collaborators.
   - Closeness centrality indicates how quickly an author can reach everyone else in the network.

Utilize hierarchical clustering techniques, such as the Girvan–Newman or Louvain algo-

rithms, to group authors based on similarities or distances and detect communities in the network.

Next, use Pyvis to bring the network data to life by generating a dynamic and interactive web-based representation of the network (rendered using HTML and JavaScript). Customize the colors, shapes, sizes, and labels of the nodes and the edges to best present features of the network.

5. **Communication of findings.** Librarian cooks are encouraged to instruct in open science practices and actively promote open science principles throughout the cooking process. To enhance reproducibility, transparently share methodologies and data, leveraging platforms such as Github, OSF, Zenodo, Dryad, and your institutional repository for code and data dissemination. Additionally, hosting the interactive network on a web server will allow users to explore and interact with the network in an intuitive and engaging manner.

CHEF'S NOTES

This recipe is highly customizable. Cooks are encouraged to tailor their approach based on their unique goals and constraints. For instance, consider using the search interface and batch download method instead of querying from APIs; opt for the free index OpenAlex rather than subscription-based tools; or choose user-friendly software that does not require coding, such as Gephi for network analysis, as an alternative to using Python.

Maintenance can be a challenge in collaborative projects like this. To make sure that the food has a long shelf life, it is critical to plan ahead and proactively implement a sustainable and comprehensive maintenance strategy.

ADDITIONAL RESOURCES

Rieger, O. Y., & Schonfeld, R. C. (2023, April 24). Common scholarly communication infrastructure landscape review. *Ithaka S+R*. https://doi.org/10.18665/sr.318775

Menczer, F., Fortunato, S., & Davis, C. A. (2020). *A first course in network science*. Cambridge University Press. https://cambridgeuniversitypress.github.io/FirstCourseNetworkScience/

NetworkX, https://networkx.org/

Pyvis, https://pyvis.readthedocs.io/

Sample Jupyter Notebook for network analysis, https://github.com/ShenmengXu/acrl-os-cookbook/blob/main/Network%20Analysis%20Example%20for%20ACRL%20Open%20Science%20Cookbook.ipynb

Layering the Community Cake:

Making a Geo-Enabled LibGuide for Community Connection and Development

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NUTRITION INFORMATION

This recipe will help chefs combine the pantries of local knowledge experts, geography and spatial information specialists, and librarians to craft a rich and varied dish for community innovation and engagement—a geo-enabled LibGuide. A geo-enabled LibGuide combines geography, open science, open education resources (OER), and a platform such as Springshare LibGuides (or WordPress site or e-newsletter) to create a dynamic, interactive learning environment that bridges library and community knowledge to create authentic geospatial research experiences.

Geography educators must teach a range of introductory geographic concepts to an array of disciplines across campus. Everything happens somewhere and therein lies the heart of geography—the exploration of space and place. Geographers can partner with campus libraries to promote cross-disciplinary geo-literacy. The campus or community library acts as a centralized contact through their knowledge, resources, and events, while LibGuides allow embedded collected texts, student projects, spatial information such as ESRI StoryMaps, and other resources to be shared in a dynamic format with and between educators, organizations, and the community. Moreover, the interdisciplinary nature and reach of LibGuides relates well to generating interest. As Dr. Kerski, who served as President of the National Council for Geographic Education states, "It's okay to be a little bit geeky about your profession. If people see that you are really passionate about something they are interested and want to learn more, oftentimes" (Kerski, 2022).

Springshare LibGuides can be used by librarians and others to support geographic literacy through open science by increasing transparency, collaboration, and sharing. Public Participatory Geographic Information Systems (PPGIS) is a theoretical basis and methodology approach that fuses expert geospatial technical knowledge with expert local knowledge to construct a pervasive understanding of community often through a shared community experience reflecting on one place, map, or issue. A PPGIS approach provides a structured approach so that academic experts (librarians, geographers, topical experts) and the local lived experiences from community members can jointly shape the Libguide. Volunteered Geographic Information (VGI) provides the ability for the community and non-experts to voluntarily contribute geographic data such as to local citizen science projects, community mapping, or local history through open, decentralized, and often asynchronous contributions which overtime builds up a relationship between everyone involved.

Volunteered Geographic Information (VGI) is "arguably the most significant change in the whole history of cartography" (Perkins, 2013). VGI provides multiple entry points for participants to contribute both spatial information and local knowledge to a spatial project. A spatial project can be any project that collects, analyzes, or visualizes geographic data from hand drawn maps with colored pencils to using OpenStreetMap to assist with humanitarian aid response for shared experiences such as flooding.

However, VGI does have one limitation—an inability to capture its own processes and construction methods. Future community explorers are left only with the results of a project, not with a recipe that they can adapt as their community changes and evolves. Geo-enabled LibGuides provide a solution to this problem by providing a mechanism for capturing not only data, information, and knowledge but also the processes that produced these results by providing a place to find spatial meta data on what was done, why it was done, what was thought of it, and

how to make it better the next time for your specific audience. In short, Geo-Enabled LibGuides allow the proverbial cookbook to be passed down from generation to generation, accumulating notes, and wisdom for future chefs.

LEARNING OUTCOMES

The geo-enabled LibGuide combines library expert knowledge, geography expert knowledge, and community local knowledge and supports learning objectives from different models, benefiting both students and the public. Baking with Bloom's Taxonomy is a recipe for success:

- understanding: Students will interpret geographic information and understand spatial relationships, increasing geo-literacy and data fluency and becoming vested learners.
- applying: Students will use geographic tools to analyze temporal events, specific topics, or regional issues.
- analyzing: Students will compare geographic analyses to identify patterns and relationships, creating new knowledge using open-source geospatial tools and datasets.
- evaluating: Students will assess geographic information-based quality, reliability, usability, and geo-ethical considerations.
- creating: Students will synthesize complex geospatial and geographic information to create materials for the geo-enabled LibGuide, curated through thematic topic tabs.

Other learning outcomes include meeting several Geospatial Technology Competency Model (GTCM) metrics and approaches. The model features approaches such as spatial thinking or the ability to understand and reason about space, place, and geographic relationships, technical skills or competencies related to data use, geospatial analysis, and visualization, application or the practical use of geospatial tools and technologies to real world problems, open data sharing and collaboration or the ability to use, integrate, and distribute geospatial datasets across users and platforms. The geo-enabled LibGuide is also aligned with National Geographic's Geo-Inquiry Goals, including promoting interactions with open data and interconnections between space and place and applying inquiry-based learning by focusing on the multi-scalar nature of our lives from local to global and regional, the interaction of the human and physical world, and topics from cultural to zoological (National Geographic, 2023).

Combining expert knowledge from faculty, students, organizations, and associations with local knowledge from the campus and community is essential for constructing a better understanding of any community. Geo-enabled LibGuides can facilitate this process by bringing together students, librarians, geographers, and community members to work on projects that are meaningful to everyone involved.

NUMBER SERVED

Serves one to everyone.

One of the prime benefits of this recipe is that it scales perfectly for any sized team! Anyone and everyone engaged in a community outreach project can benefit from this recipe's production.

COOKING TIME

Community engagement is not a 'one and done' process. Times will vary, and some steps will remain an ongoing practice. It is therefore important to establish which pieces of the LibGuide will be a store of comparatively static references and which will be ongoing processes and to identify any variations between those two extremes. Not least of all, this will be important in public engagement and citizen science, as participants will need clear guidelines.

DIETARY GUIDELINES

Open approaches are the great democratizer; everyone has access to them. The more data, information, knowledge, and processes are shared and built upon, the more they can be used to create novel solutions and place specific innovations to community problems and issues. Libraries play a key role in sifting through all the big data and big data repositories out there to create a curated and organized cupboard for the types of recipes we know the public will enjoy.

LibGuides provide a store of information and knowledge and should be constructed with an eye to transcending a university setting. When set to open to the public, the greater public often responds by providing content,

events, resources for open science and open data engagement. The materials and knowledge generated at the campus level begin to have broader applicability. Julia Child said, "The more you know, the more you can create. There's no end to imagination in the kitchen." The more in the LibGuide, the greater the potential for creativity.

INGREDIENTS AND EQUIPMENT

To paraphrase Betty Crocker, the great thing about cake mix is that it permits you to use your wonderful talent without drudgery. VGI can be considered a form of geospatial cake mix—simultaneously powerful and accessible, yet adaptable to a range of community problems. Examples include transcribing historic journals for the Smithsonian, responding to humanitarian crisis through Humanitarian OpenStreetMap, and noticing the birds outside your window with one of the oldest VGI mixes, the Great Backyard Bird Count.

Funding agencies and government institutes like NASA and the Library of Congress offer lessons, collaborations, grants, and internships using open science and open data designed to involve librarians, educators, and the public. Do not overlook local gems such as state environmental agencies and local community groups.

Be sure to use a variety of VGI, geographic resources, and local expertise in your LibGuide.

A SpringShare LibGuide platform or similar content management platform is one of the most versatile tools in your kitchen. The specs on a LibGuide are ease of use and customization, which frees up time to focus on building community relationships and doing geography. A geo-enabled LibGuide can use a variety of VGI and contextual geographic resources, including maps, data sets, images, and videos. Most will even manage search engine optimization, checking URL links, and multimedia functionality.

COOKING METHOD

In general, VGI activities with short chunks of cook time from twenty minutes to forty-five minutes help users maintain focus and ensure quality recipe outcomes for cooks. However, the length of time needed for VGI activities is variable and dependent on the sous chef's expert prep of materials ahead of time as well as a careful pairing of the capabilities of the chef, the users, and auxiliary data collection tools used in citizen science. For example, the time needed for transcribing journal narratives for digital humanities will differ from an OpenStreetMap project. Prescribed efforts like a Map-A-Thon might require an intensive cook time for participants. However, a broader social media capture and reporting activity might require a longer, slower cook time for participants. Geo-enabled LibGuides should contain a mix of these entry points for both geography experts and community members. Participants can opt for entry and engagement points that best meet their personal and professional needs.

Although bootstrap methods like a mix can help, it still takes expertise to make a multi-layered, attractive, complex, and delicious cake. Domain experts, local experts, and geo experts can adapt the stock ingredients available in their respective pantries to construct a compelling, creative, and potent set of recipes.

A no-bake cookie recipe approach might be to promote the first, oldest, and one of the largest citizen science projects, Audubon's Christmas Bird Count, in which anyone can take part and make a difference contributing to bird migration data collected since 1900 through a board game night with games such as Wingspan and sharing birding books (Siwela, 2022).

A quick bread approach is to talk about how the public uses Digital Public Goods (DPG), a shared resource that is available to the public, such as open-source software, open data, or open standards in their everyday life. OpenStreetMap is one that almost everyone uses and can be tied into events such as Poetry Month Haiku Death Matches by promoting the OpenStreetMap Haiku Generator which was created using open data and is a fun exploration of haikus generated for specific locations worldwide—even theirs (hopefully) and can lead to discussions of the digital divide.

One cooking method involves combining your ingredients into a citizen science map-a-thon, which features citizen science or community science activities that can be directly connected to existing library resources.

A map-a-thon is like a catering opportunity for volunteers to digitally connect and create urgently needed data for communities around the world so that local and international decision makers can use these maps and data to better respond to interests, issues, and research affecting these areas. Organizations like SciStarter.org and Humanitarian OpenStreetMap (HOT) offer searchable repositories of available projects and skill levels. Members can create lists of favorite recipes to share and consider curating your own.

The geo-enabled LibGuide becomes a gateway into talking about how to use and access geospatial datasets for community purposes. GIS is more than a software—it's an approach to understanding the world and the big data that surrounds us.

Your citizen science map-a-thon has two parts. After you have picked a theme or project with students or librarians, first, draw the public into your baking event by letting them work individually at their own pace, or with guidance from the SciStarter tutorial Foundations of Citizen Science. Second, encourage the community to complete specific VGI project(s) over a specific period of time, ranging from one hour to several event days.

Congratulations! It is relatively simple to include the community, put your library on the map, and make a difference in the world. Make sure to share the results and congratulate your community and stakeholders on their impact to get them vested in learning more—at the library!

An example of steps you can take in making a plain cake or cupcakes that can be modified by different cake themes is to use a day of observance or holiday calendar as your starting point.

- Start your recipe with the day of observance, such as a local or national holiday or event (e.g., Earth Day, GIS Day, the Great Backyard Bird Count, or a local festival).
- Identify your community or stakeholders (students, local organizations, service groups)
- Search for your topic area and the terms "citizen science," "participatory geography," and/or "volunteered geographic information VGI" in state and federal citizen science repositories such as zooniverse.org, scistarter.org, or citizenscience.gov.
- What you cannot find becomes your gaps analysis or where data is missing in your local area and could be used to involve the students and community with decision makers in their local area.
- Choose a participatory method such as community mapping, participatory workshops, or collaborative data analysis depending on what meets your needs or time frame.
- Empower communities and facilitate their active participation in spatial planning and decision-making processes such as promoting community calls for input on neighborhood maps, flood maps, parks and others that might be requested.
- If you have the time, consider being part of a larger on-going project in your community or in partnership with other communities, libraries, and schools.
- Put your event on your LibGuide and website, along with related geographic context at different geographic scales from local to global, open science exploration from pre-packaged sites such as those created by NASA, SciStarter, Association of American Geographers (AAG), American Geophysical Union (AGU), and geospatial industry partnerships such as ESRI GeoInquiries, and open data for those who have more technical proficiency.
- If you have several events planned, think about doing freezer prep such as on a schedule or calendar. Design sites such as CANVA have the capability to create pre-scheduled calendar uploads to save time.

CHEF'S NOTES

Geo-enabled LibGuides can be powerful tools for community engagement if their content addresses the complexities of the project and matches that content to the expertise and capabilities of its participants. One challenge is bridging the sometimes formidable gap between expert geographic knowledge and expert local knowledge within the same LibGuide. PPGIS and VGI can alleviate some of this gap, but the real power comes in the

passing down of processes and techniques discovered during the construction of this particular iteration of a perhaps treasured, perhaps newly found recipe.

If starting from scratch, SpringShare has a community of shared LibGuides, if you don't have the time to learn new equipment.

While many people use mobile devices to access library resources and most phones are geo-enabled, you will want to have some activities that are accessible in other ways.

Follow usability guidelines to ensure that any material is easy to navigate on desktop and mobile devices.

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Undergraduate Service with a Side of Community Science

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NUTRITION INFORMATION

This recipe will guide librarians interested in building a structured community science project. This project may be a partnership with faculty as part of a course, a partnership with relevant student clubs, and/or a means of fulfilling a student service requirement. All pathways are opportunities to get students actively engaged in community science.

LEARNING OUTCOMES

Readers of this recipe will be able to:

- identify the benefits of collaborating with external agencies;
- create lesson plans that incorporate concepts from the ACRL *Framework for Information Literacy for Higher Education* and the STEM Framework companion; and
- anticipate challenges that might arise during the development and/or implementation of a community science service program.

NUMBER SERVED

This recipe is designed to serve between five and twenty-five undergraduate students, though it can be adapted for more if needed.

COOKING TIME

Total cook time, including preparation, is two to twelve months and includes time spent forming partnerships, planning, recruiting students, organizing travel (if needed), and performing the community science activities.

DIETARY GUIDELINES

Community science, like the Audubon Society's Great Backyard Bird Count, is integral to many research endeavors and frequently involves the collection of data on a scale and with geographic reach that individual researchers or research teams cannot achieve. Community science endeavors typically do not require that participants possess deep subject expertise, which makes them accessible to undergraduates who may not be pursuing science degrees and librarians who may not be subject experts.

Whatever pathway a librarian takes to lead an undergraduate community science effort (e.g., a service learning department, a course, student groups), their involvement allows them to connect aspects of community science to open science and other information and data literacy concepts. Librarians should draw inspiration from both the ACRL Framework and the STEM Framework companion to help develop relevant learning outcomes.

INGREDIENTS AND EQUIPMENT

The flexibility of this recipe means that some of the following ingredients can be substituted to taste:

- A cook or team of cooks, which can mean you working alone, you working with another leader to manage the kitchen, or you working with a service learning department and/or with another faculty member as part of a course requirement.
- One partner organization, which should have an established community science program. (See Additional Resources for examples.)
- Funding may or may not be needed and can be highly variable.
- Travel arrangements, which can range from on-campus meetings to international air travel.
- Survey equipment or supplies, which can be as simple as a pencil and notebook or a phone app or as complex as rented dive gear and specialty underwater slates. The project and partner organization you select will be the main determining factor for this ingredient.
- Protocols, i.e., methods and standards for collecting, recording, and submitting data. You should understand what your partner organization expects of your students so that you can effectively teach and answer questions they may have.
- Your secret ingredient—the Framework and STEM companion. Use these to create learning objectives that relate your community science project to informa-

tion and data literacy concepts.
- Students! This ingredient is not optional, and you should work to source students who are truly interested in the subject matter and project for this dish to have maximum effect.

PREPARATION

Proper preparation of the ingredients is key to a successful dish. Note that steps one and two may be interchanged or happen concurrently depending on your kitchen habits and other cooks.

1. Identify potential partner organizations whose community science efforts align with your vision. Start shopping for this ingredient first, as it will shape the flavor profile of the entire dish.
2. Confirm your team of cooks.
   - If you are working through another department, you may find that they are able to help with a lot of the prep that follows.
   - If you are working with a faculty member, your team may be ready-made! If this is a new project, you may still find it advantageous to reach out to your service learning office. Courses may be designed to help students fulfill graduation requirements for service, and this office can ensure your efforts align with expectations.
   - Ensure pursuing such a project is supported by library leadership. If you are working outside of any institutional education requirements such a project might help fulfill, you may need to demonstrate the educational and experiential value of this approach to community service with students.
3. Find interested students. Unless your project is part of a course requirement, you'll need to do some marketing. You may find that marketing happens in two waves. You can use this first wave to gauge interest, but be sure you keep a record of students so you can contact them if/when it is time to select a group. These initial efforts should also have some information regarding rough estimates of what will be required of the student. Later marketing should include specifics, including costs, time commitments, and overall expectations.
4. Address administrative details. If there is travel involved, ask yourself and others questions like:
   - When is this happening?
   - What will be required for me to take a van full of students out for the day?
   - What requirements does my institution have for students to travel out of the country?
   - Where will we stay?
   - What if a student hurts themselves?

Asking these kinds of questions early will save a lot of time later and can help you keep your cool when things really get cooking in the kitchen.

5. Develop learning outcomes. Amidst all of the details that might seem more important, it is easy to procrastinate this step, but start developing outcomes now. There may be certain outcomes required or desired by your team of cooks. Remember that you are one of those cooks, and it's time to prepare your secret ingredient! Break out the Framework and STEM companion and use this opportunity to demonstrate how much value you bring to the kitchen. You can develop the knowledge practices to suit your needs, and if you want to try to get at some higher order concepts, you can do the same using the dispositions listed in the Framework and STEM companion. Just know that dispositions can be a little more difficult to assess.

You will want to develop learning outcomes specific to your needs, but here are two examples that could be common to many recipe variants.

Participants will:

   - understand the role of community science within the larger scientific community and
   - collect and submit data for inclusion in a database open to researchers worldwide.

6. Design and develop activities. A community science project will necessitate certain activities, such as conducting bird, frog, or fish population surveys; collecting water or soil samples; submitting data, etc. Now is the time to connect these to your outcomes. You will also need to

develop activities that facilitate any necessary training for you and your students (see Cooking Method).

7. Select the students (may not apply to course-integration recipe adaptations). If more students apply to participate in the program than you have space available, you will need to make selections—randomly, on a first-come-first-served basis, or by asking applicants to write a brief response explaining why they want to participate (more time consuming, but recommended if you have a lot of interested students). Pro tip: identify a few students as alternates in case any of your original selections are unable to participate.
8. Host an information session. This is a chance for you to set expectations, ensure everyone understands the schedule, etc. It is also a chance for your students to ask questions. This is *mise en place* preparation. Protocol training is part of the cooking, so resist the urge to cover that here.

COOKING METHOD

1. Host necessary trainings for the project. Some organizations have training materials; a course may have training baked in. If not, I recommend a shared learning model where you model learning alongside your students. This step should focus on expectations of your group as you work with your partnered organization. For example, if you are conducting population surveys, your group will need to learn how to pick out key identifying characteristics of that population as well as proper tallying technique. The Reef Environmental Educational Foundation (REEF) surveyors record identified species not by counting exact numbers, but by recording "single," "few," "many," or "abundant" (S = 1, F = 2-10, M = 11-100, A = >100). Aspiring surveyors might learn to recognize visual markings, audio cues, or a combination of both to conduct their surveys. If there is a data collection component, discuss how data submission works.
2. If necessary, travel, and then—do the work! This is where your group will do things like identify and note the sounds of various frog species, count how many of each fish species they encounter in a roving diver survey, or properly collect and mark water samples for quality testing.
3. Incorporate discussions and other activities. Discussions are a place for students to talk about what they did, found, saw, or otherwise experienced. While they may be tired, students will still be excited with the activity fresh in their minds. You might then guide the discussion toward concepts from your learning outcomes. Other activities can also integrate elements from your learning outcomes, e.g., honing species identification, working with an outside expert, or looking at the real-world applications for the work your students are doing and how their efforts might benefit the scientific community.
4. Follow through. It's time to plate up your dish! Submit a first set of data as a group so that everyone is clear on the proper procedure. This is a great time to introduce/reinforce the importance of open science practices.
5. Host a summative discussion. To get the full nutritional value out of this recipe, be sure to have a final guided discussion to evaluate whether your learning outcomes were met and get student feedback.

CHEF'S NOTES

- Some projects may carry more inherent risk than others, but accidents can happen even while birdwatching. Understand your institution's policies and procedures, and be aware that fieldwork may entail extra institutional paperwork.
- If you decide to incorporate travel, become an expert on how your institution handles travel and who to contact to get things straightened out if arrangements somehow get jumbled.
- There are many ways to alter this recipe to make it more accessible or to spice it up by adding complexity. The roving diver surveys through REEF, for example, can be as elaborate as traveling out of the country and scuba diving to conduct surveys. But there are also many domestic opportunities to collect survey data for REEF, and snorkeling is a perfectly viable way to do so.
- Simplify for comfort food. By working with local ingredients (and fewer of them), you can really make this recipe a breeze. You can connect with any number of national, state, or local organizations to monitor or count birds,

bats, snakes, frogs, toads, or many, many other creatures! There are numerous water and soil monitoring projects, a project that measures and maps the urban heat islands of cities, and even a project that needs community help analyzing cloud formations on Mars! Try searching "community science" or "citizen science" in conjunction with your state, local area, or type of science you wish to pursue. Select a project that interests you and makes sense for your students and institution.

ADDITIONAL RESOURCES

- Citizen Science Catalog, https://www.citizenscience.gov/catalog/#
- Great Backyard Bird Count, https://www.birdcount.org/
- NASA Citizen Science, https://science.nasa.gov/citizen-science/
- National Geographic Citizen Science Projects, https://education.nationalgeographic.org/resource/citizen-science-projects/
- REEF Volunteer Fish Survey Project, https://www.reef.org/programs/volunteer-fish-survey-project

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