

Scientific Reading & Writing

魏桐

研究院数字化地球所

2/22/2023

- About this course, *Scientific Reading & Writing*
 - Course goals, learning objectives, and grading
- Contents
 - Scientific Reading
 - Scientific Presentation
 - Scientific Figure
 - Scientific Writing
 - Scientific Reviewing

Part I

About this course

文献阅读与科技写作 (Scientific Reading and Presentation)

- 专业选修课，学分2，周学时4 x 8周=32
- 课程介绍：《文献阅读与科学展示》是一门以文献阅读和展示分享相结合的课程。文献阅读是当代科学研究中的一项重要基础性工作，是科研人员集思广益、提出问题、设计实验、分析数据、得出结论、撰写论文、发表成果、进行交流、推动学科发展的关键环节。通过本课程的学习，使学生掌握文献阅读的基本方法，了解基因组学研究的背景，熟悉生物信息学的研究方法，养成良好的文献阅读习惯。
- 授课方式：45分钟讲授（本人或者嘉宾），150分钟学生分享讨论（启发式提问）。
- 目标：通过学习本课程，学生应该掌握文献阅读的基本方法；了解基因组学研究的背景；熟悉生物信息学的研究方法；养成良好的文献阅读习惯。
- 考核方式：平时成绩占60%，包括考勤（10%）、ppt展示（40%，团队打分，2次机会）、随堂提问（10%）；期末考试，包括项目汇报（30%）、课后问答题（10%）。

Contents

- Introduction of scientific reading and presentation
 - The history of sequencing technology
 - Literature about human genomics
 - Literature about evolutionary genomics
 - Literature about population genomics
 - Literature about functional genomics
 - Literature about recent omics approaches
 - Final presentation
- Focus on human research

Learning materials: websites

- Nature milestones on genomics sequencing: <https://www.nature.com/immersive/d42859-020-00099-0/index.html>
- Human genome project, <https://www.genome.gov/human-genome-project>
- 1000 Genomes, <https://www.internationalgenome.org/>
- ENCODE, <https://www.encodeproject.org/>
- Epigenome Roadmap, <http://www.roadmapepigenomics.org/>
- The Cancer Genome Atlas, <https://www.cancer.gov/about-nci/organization/ccg/research/structural-genomics/tcga>

CourseReading2021>CourseReading2021>reading1technology

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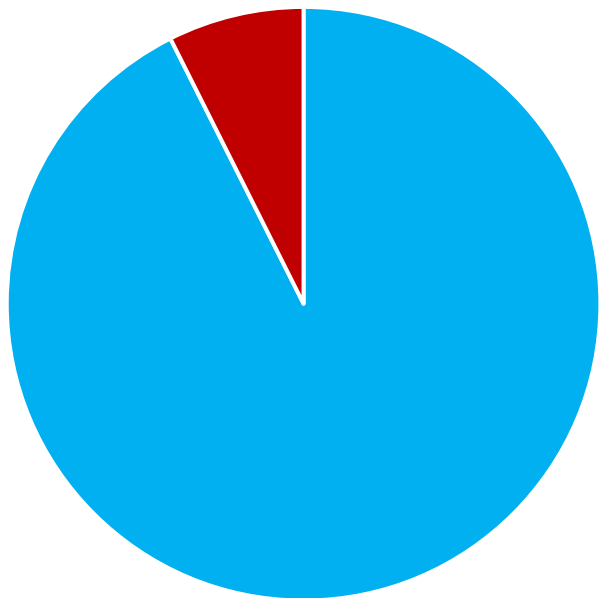
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1 1977 (pnas) A new method for sequencing DNA.pdf	2021/08/31 10:20:24	1.76MB
1 1977 (pnas) DNA sequencing with chain-terminating inhibitors.pdf	2021/08/31 10:20:25	2.05MB
1953 (nature) Molecular structure of nucleic acids a structure for deoxyribose nucleic acid.pdf	2021/08/31 10:20:26	143.42 KB
2 2005 (nature) Genome sequencing in microfabricated high-density picolitre reactors.pdf	2021/08/31 10:20:26	1.11MB
2 2005 (science) Accurate Multiplex Polony Sequencing of an Evolved Bacterial Genome.pdf	2021/08/31 10:20:27	564.24 KB
2012 US20120160687A1 Characterization of individual polymer molecules based on monomer interface interactions.pdf	2021/08/31 10:20:28	2.87MB
2016 (genome bio) The Oxford Nanopore MiniON.pdf	2021/08/31 10:20:28	920.72 KB
2021 (nat methods) Haplotype-resolved de novo assembly using phased assembly graphs with hifiasm.pdf	2021/08/31 10:20:29	3.55MB
3 2003 (science) Zero-Mode Waveguides for Single-Molecule Analysis at High Concentrations.pdf	2021/08/31 10:20:31	672.44 KB
3 2016 (nat biotechnol) Three decades of nanopore sequencing.pdf	2021/08/31 10:20:34	7.48MB

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Grading

- Weekly seminar (25% each)
 - ~40-minute talk + 10-minute question
 - Tutor + peer evaluation (on-line survey)
 - Style/format (5%) + presenting (5%) + background (5%) + results (10%)
- Discussion (25%)
 - Q & A, reporting in 2 days (1-2% each)
- Final presentation (25%)
 - 8-minute talk + 1-2 questions

课程满意度



■ 满意 ■ 一般

- 敢于分享
- 从嘉宾分享和老师点评中学到很多
- 提升了**科研思维**与科研能力
- 学会了汇报ppt的制作和讲解，听了很多大佬的讲解
- 在阅读文献，PPT制作和文献展示等方面有较大提升
- 优化文献阅读与展示的**技巧**，系统地接触到各领域**前沿知识**

学术道德与学术论文写作 (Research Ethics and Scientific Writing)

- 公共必修课，学分1，周学时3 x 8周=24
- 课程介绍：良好的学术素养包括端正的研究态度和优秀的学术规范。学术道德是学术研究的基石，是衡量学术成果质量的重要标准。本课程旨在通过理论学习和实践训练，提高学生的学术道德素养和学术写作能力，为日后从事科研工作打下坚实基础。
- 授课方式：45分钟讲授，120分钟学生分享讨论（启发式提问）。
- 目标：通过经验分享、写作训练、分组和课堂讨论，帮助研究生提高学术写作能力。结合研究生培养的开题报告、学位论文写作要点、SCI论文投稿流程等方面，为完成培养阶段相关的论文写作任务提供必要的知识与技能提升。
- 考核方式：两次展示（各10%）、三次写作（开题10%，中期20%，期末30%）、随堂提问（20%）。

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Syllabus

	Course	Assignment(s)
Week 1 (10/17)	Introductory talk + grouping	1-page research proposal + (optional peer review) by 10/31
Week 2 (11/2)	Proposal talk (10 min) + Scientific figure	Midterm report w/ peer review by 11/30
Week 3 (11/9)	Proposal talk (10 min) + Group discussion	
Week 4 (11/23)	Presentation I (20 min) + Manuscript preparation	Final report w/ peer review by 12/31
Week 5 (11/30)	Presentation II (20 min) + Submission	
Week 6 (12/21)	Team sharing (30 min) + End talk	Student survey

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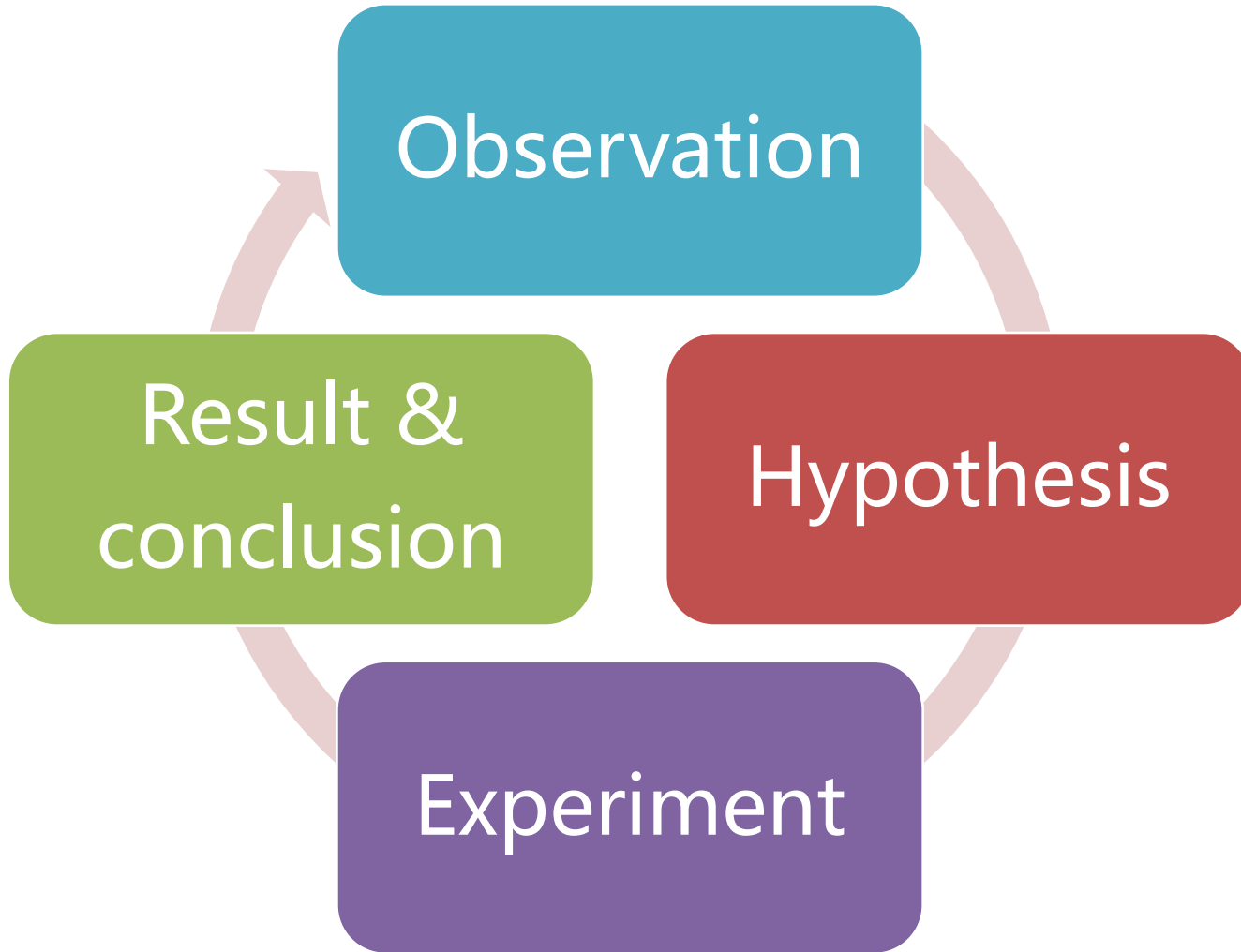
Grading

- Research proposal (20%)
 - **Proposal** (10%), tutor grading based on **format** (5%) + **timing** (5%)
 - **Presentation** (10%), **peer grading** (format 2%, background 4%, methodology 2%, presenting 2%)
- Midterm (30%)
 - **Report w/ edits** (20%), tutor grading based on **format** (5%) + **timing** (5%) + **≥3 peer-review** (10%)
 - **Presentation** (10%), **peer grading** (format 2% + background 2%, results 4%, presenting 2%)
- Final (30%)
 - **Report w/ edits** (20%), tutor grading based on **content** (10%) + **timing** (5%) + **≥3 peer review** (5%)
 - **Team sharing/discussion** (10%), tutor grading based on **attitude**
- Engagement (20%)
 - **Peer review + grading** (1% each)
 - **Q & A** during course + on the [github](#) (1-2% each)

- 问：作图的工具有哪些？魏老师给了他们小组作图的练习课件。
- 问：通过生信分析，得到的基因型-表型相关性如何验证？答：某些算法可以一定程度上检验因果联系，但湿实验是最可靠的‘金标准’。
- 问：以实验为主的同学是否有必要学习生信？答：最好能跟着项目组学习下生信的技能。
- 问：如何给自己博士学习阶段定一个合适的目标？答：能独立完成一个完整的项目，并完成学术论文的写作。
- 问：博士阶段最需要培养的能力以及科研生涯的规划？答：科研思维的培养与论文写作全流程的实践。结合未来职业发展规划及自己的能力，拟定属于自己的计划，多与同行沟通。
- 问：博士毕业之后的未来生涯选择？答：要明确自己未来想做什么，继续做研究然后可以考虑博后或者出国再增加一些见识，也要了解想去的院校相应条件和要求。

Learn from **tutor & peer!**

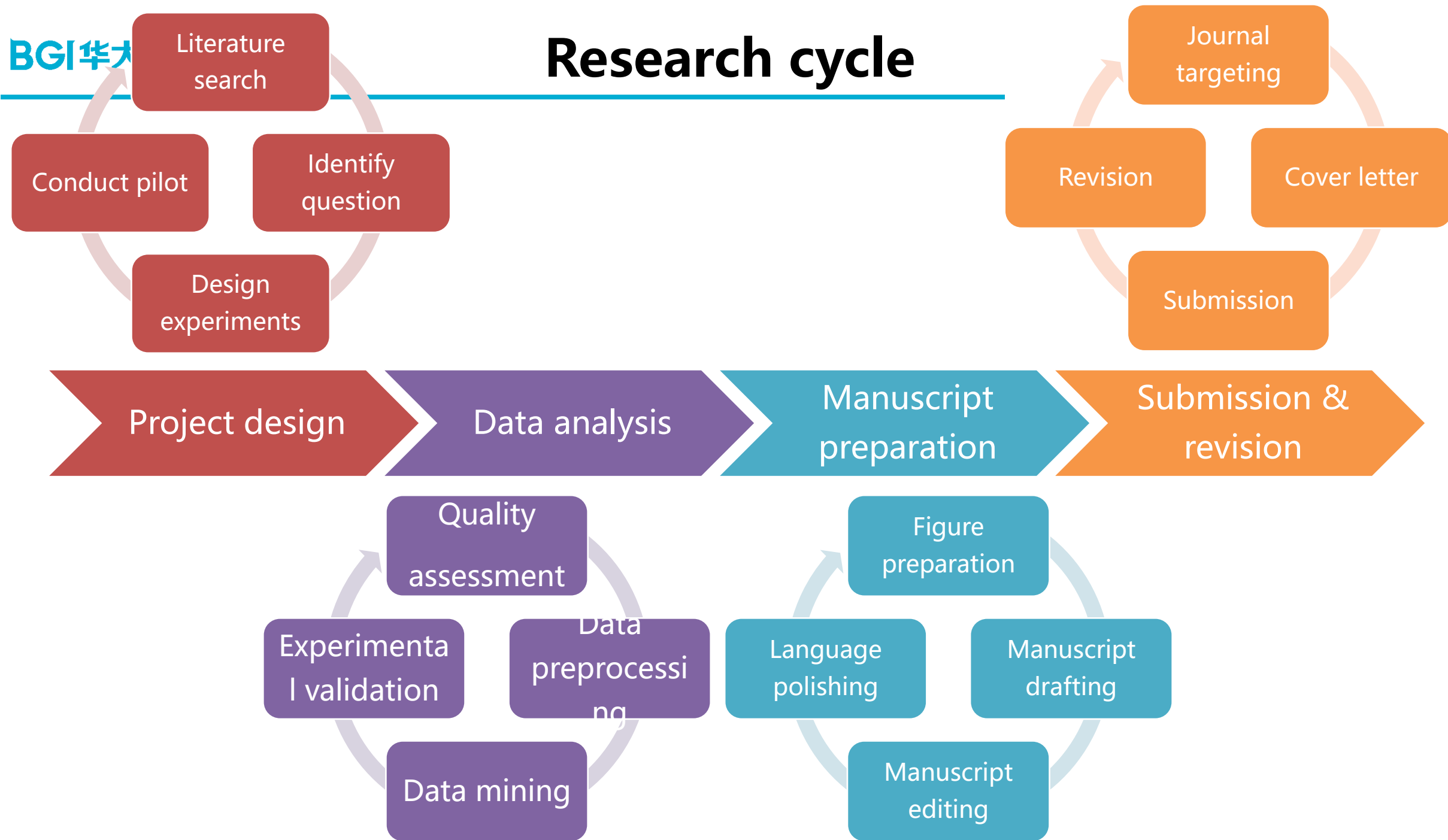
Learn by **practice & discussion!**



An empirical method of **acquiring knowledge** from observations.

It **applies to all** scientific enterprises.

Research cycle



- Project design
 - Clarify **scientific question(s)**
 - Choose approaches, i.e. objects + techniques
 - Survey/predict the trend in publication
- Data analysis
 - Data quality control
 - **Repetitive pipeline/code**
 - Plan **experimental validation**

BGI华大 Things to do in research cycles (continued)

- Manuscript preparation
 - Make **self-explanatory figures**
 - Draft **an outline** and follow it
 - Polish the English writing
- Submission & revision
 - Pick a right journal(s), broad or narrow audience
 - Prepare for **major revision**

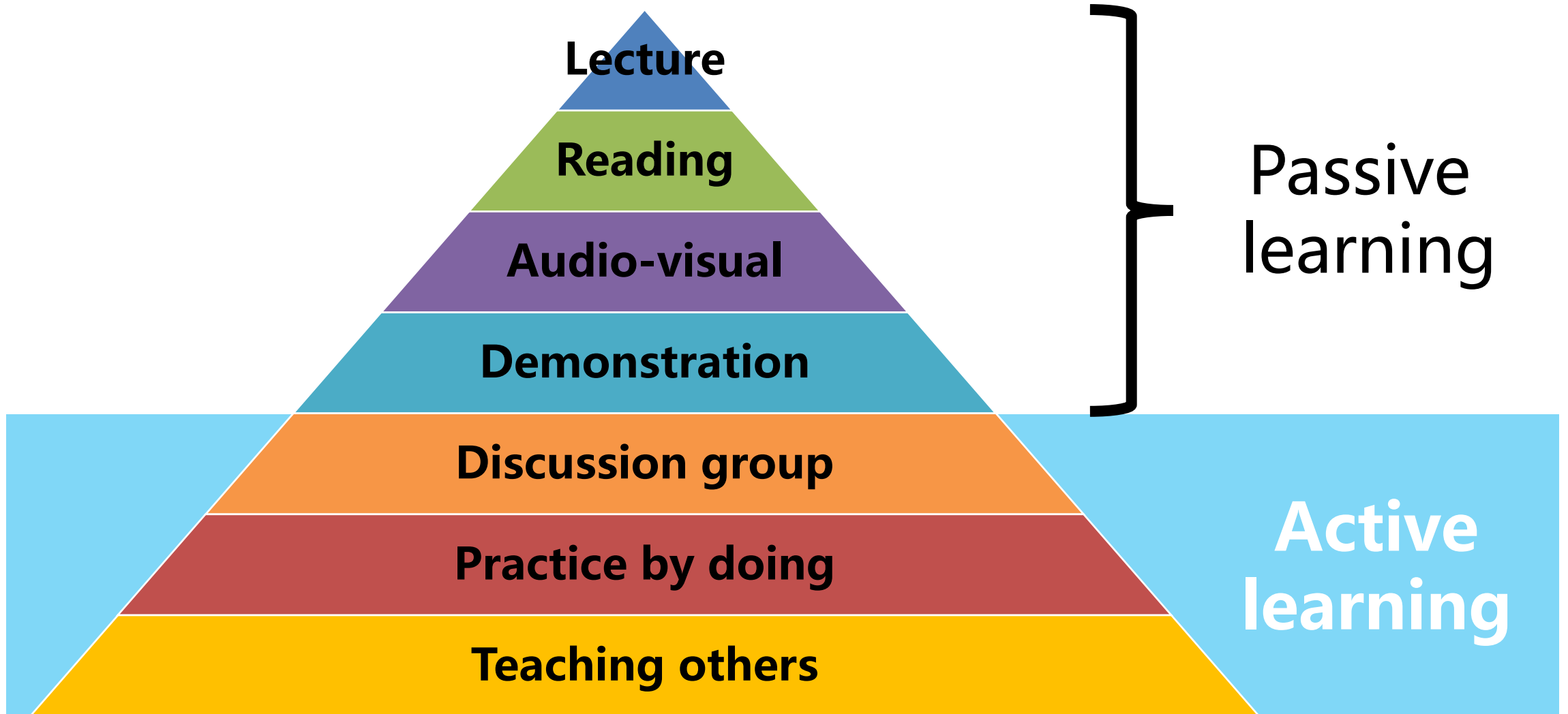
Abilities required for life science research

- The ability to **read and write scientific papers**
- The ability to **think independently**, and solve problems
- The ability to **employ a variety of techniques**
- The ability to **engage in dialogue** using appropriate scientific language
- Others skills like communication, interpersonal, practical, self-management and so on

Skills required for research

- **Conceptual/intellectual skills**, read and summarize literature critically, identify and frame **key problems**, think critically and analytically, recognize moral and ethical issues
- **Practical skills**, undertake sufficient work, design/plan/conduct/report investigations, obtain/record/analyze data, conduct work in a safe and responsible manner
- **Communication/presentation skills**, **present research** in a scientific manner, cite other work
- **Interpersonal/teamwork skills**, identify individual and collective goals, debate in a scientific and respectful manner, evaluate individual and team performance
- **Self-management skills**, think and work independently, develop employable skills, develop lifelong learning skills, develop resilience

Learning Pyramid



Education 1.0 VS Education 4.0



	Education 1.0	Education 4.0
	Exist in most schools, after-school programs, and private tutoring.	Used by Dream Formula Education & many leading schools.
Teaching is Done	Lecture-Based (teacher to Student)	Discussion-Based (teacher to student, students to students)
Result	Passive Learning Attitude & Low Engagement	Active Learning Attitude & High Engagement
Teaching Approach	One-size-fit-all	Personalized Education
Result	Low Interest in Learning & Ineffective Learning	High Interest in Learning & Effective Learning
Primary Role of Teachers	Lectures	Mentors
Result	Support Students' Academic Only	Support Students' Holistic Growth
Teacher Training	Degrees, Credentials, Certificates	Continuous Training
Result	Outdated Learning Materials & Teaching Approaches	Stay Updated to Today's Fast-Changing World
Learning Activities	Textbooks & Tests	Project-Based Learning
Result	Unpractical Learning Outcome	Develop Practical 21st-Century Skills
Learning Locations	Traditional Classroom Settings	Large Learning Space
Result	Limited Learning Activities	Diverse Learning Activities
Industry Views Graduates as	Assembly Line Workers	Co-creators & Entrepreneurs
Result	Not Suitable for Today's Industries	Suitable for Today's Industries
Employability	Degree-Qualified & Major-Focused	Prepared for Uncertain Multiple Careers
Result	Not Suitable for Today's Fast-Changing World	Equipped with Variety of Skills for Multiple Career Paths

BGI华大 What professors say about communication

Professor of Statistics, Susan Holmes:

Even if you're very, very good with numbers, you also have to understand how to tell your audience what results you obtained. . . It's really important for students to realize that if they want the gift of making the discovery, they have to be the ones who can tell the story.

Professor of Computer Sciences, Mehran Samani:

I've actually seen some methods of extremely powerful computational techniques which, even after they were invented, took years to catch on. Part of the reason why they took that long to catch on was because the people inventing those methods did not do a very good job explaining their methods.

(Source: Program of Writing and Rhetoric, Stanford University)

What professors say (continued)

- A successful researcher is someone who knows both how to do their science, and how to effectively **communicate** their findings through the **written and spoken** word.
- Effective writing is an important component of a scientist' s skill set and should be **cultivated at an early stage** of the career.
- This requires a knowledge of the writing and publications processes, and **a mastery of diverse** scientific presentation formats such as research and review manuscripts, abstracts, oral presentations, and social media.

HOME // USE THE COMMKIT

Use The CommKit

WANT TO TALK WITH ONE OF OUR
FELLOWS ABOUT YOUR PROJECT?

▶ MAKE AN APPOINTMENT

SEARCH THE SITE:

e.g. Article, Poster, CV



The CommKit is a collection of guides to **successful communication** in the biological sciences, written by the BRCL Fellows.

Our goal in creating this resource is to share how we, as graduate students, postdocs, and research scientists, think about conveying technical information in written, oral, and visual formats to a range of audiences.

Each guide is a short, self-contained discussion about how you can craft a successful document or presentation. To help translate theory into practice, we include annotated real-world examples like published papers and application materials from successful fellowship applications.

We designed the CommKit as a complement to our peer-to-peer coaching within the Broad Institute. While we cannot offer individual coaching sessions outside of the Broad, we hope that the CommKit will be a useful resource for the larger engineering and scientific community.

To find CommKits in other scientific/engineering disciplines, [click here](#).

Journal Articles

- General Tips
- Abstract
- Introduction
- Methods
- Discussion
- Results
- Peer Review – A Historical Perspective
- Peer Review – Best Practices

Presentations

- Slideshow
- Virtual Presentations

Visuals

- Figure Design
- Poster

Coding

- Coding, File Organization, and Documentation

Job Applications

- Elevator Pitch
- CV/Resume
- Cover Letter: General
- Cover Letter: Faculty

Fellowship Applications

- NSF Research Proposal
- NSF Personal Statement
- Grad School Personal Statement
- Fellowship Application
- NIH/NIH Center application
- Postdoc Fellowships: Index of Life-Sciences Fellowships

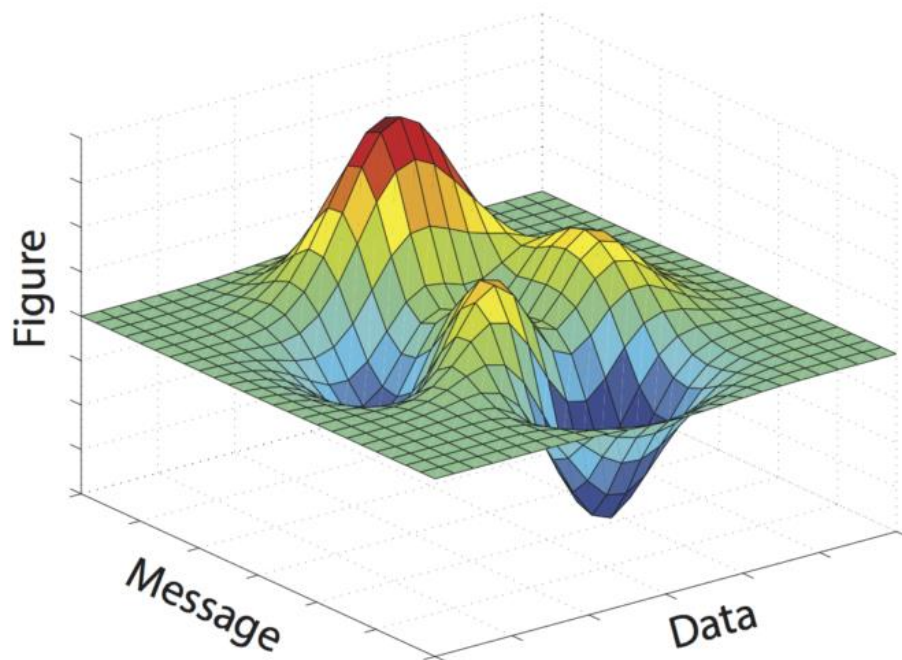
Science Policy

- Introduction to Policy Communication
- Policy Elevator Pitch
- Policy Memo
- Policy Presentation
- Congressional Hill Meeting
- Letter of Support

Criteria for Success

1. Your figure leaves the audience with a clear, one-sentence main message
2. You provide evidence that directly supports the main message
3. Any content not related to your main message is removed from the figure

Structure Diagram



Analyze Your Visual Platform

Will you be presenting your figure in an academic paper, a poster presentation, an oral presentation? The final format dictates how your audience will interact with the figure, and how much support or explanation you will be able to provide.

Visual platform	Static or dynamic?	What information goes where?
Paper	Static	<ul style="list-style-type: none"> • Figure and caption should be sufficient for reader to draw a conclusion. Expert readers judge papers' credibility and impact based on figures alone. • Caption's title should state the message. • Remainder of caption should not contain any interpretation, only high-level description of what was done to obtain data in the figure.
Poster	Static	<ul style="list-style-type: none"> • You are present and can supplement printed information with spoken explanations. • Precede figure with title that states the message. • A caption is often unnecessary: viewers can easily glance at methods to see how data were obtained. • Larger sizing allows more thorough and direct labeling than is possible for papers. Take advantage of this to make your figure more self-explanatory.
Slides	Dynamic (can be animated)	<ul style="list-style-type: none"> • Slide title should state the message. • Text should be minimized. • Animations can be used to pace delivery of complex figures. • See Slideshow Presentation for more specific skills.

Document Map

1. What is my purpose for giving this presentation?
2. Who is my audience?
3. What are the concepts for success?
 - a. Connect your work back to broader motivations and hypotheses
 - b. "Introduce" your data
 - c. Each slide should convey a single point
 - d. Emphasize visuals over text
 - e. Make each figure as simple as possible while still conveying its message
 - f. Avoid jargon, textual and visual
 - g. Prepare for the talking part of the talk

Structure Diagram

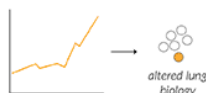
The presentation starts with something everyone cares about



The bigger theme connects to your research



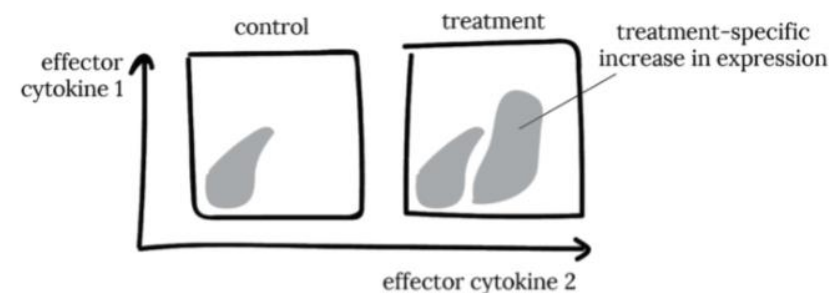
Experimental results are related to larger hypotheses



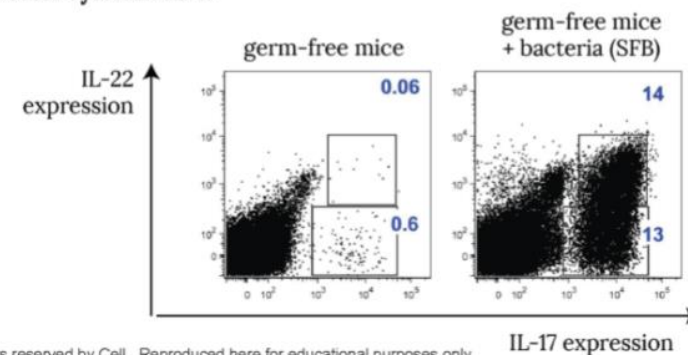
The slideshow helps you get what you want from the audience

You get funding?
You get the feedback you want from the people you want?
You get someone excited enough to start a collaboration?

Flow cytometry can show if the experimental treatment increases the expression of an effector cytokine



Adding the bacteria of interest increases the expression of effector cytokine IL-17



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Try visually explaining unfamiliar data. For an audience unfamiliar with reading FACS plots, an imaginary immunologist first shows a slide explaining how the biological signal would appear in a FACS plot (top) before showing the slide with the actual data (below). [Adapted from Ivanov et al., *Cell* (2009) doi:10.1016/j.cell.2009.09.033]

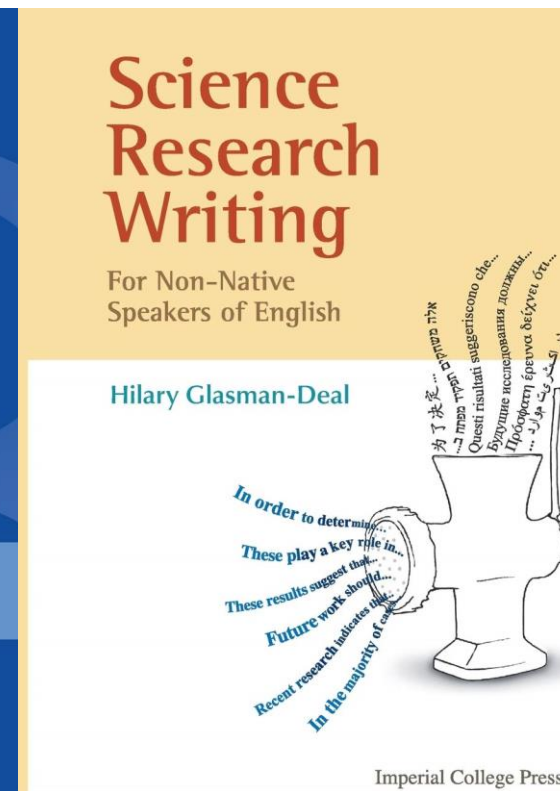
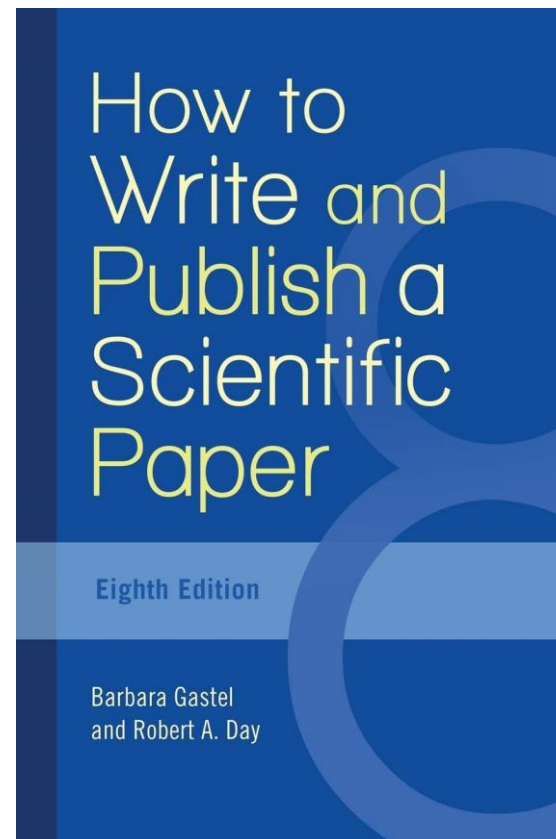
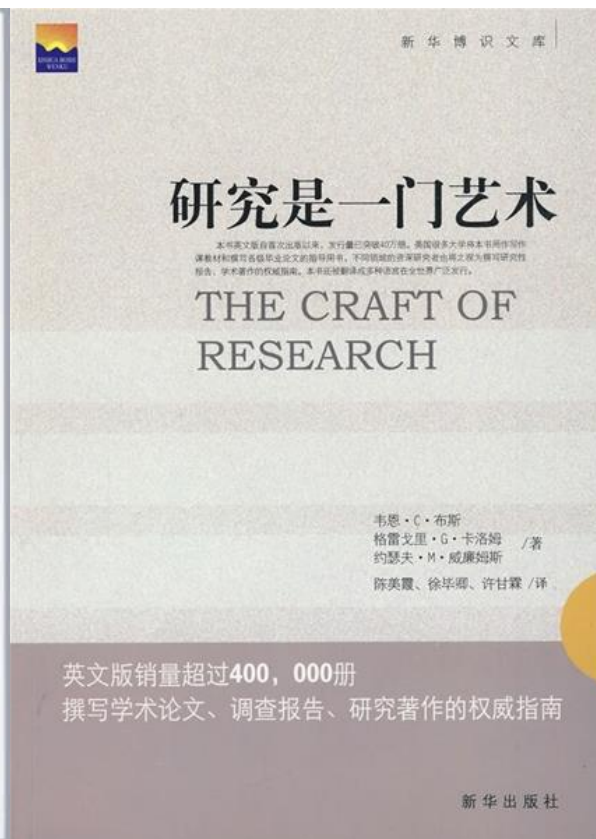
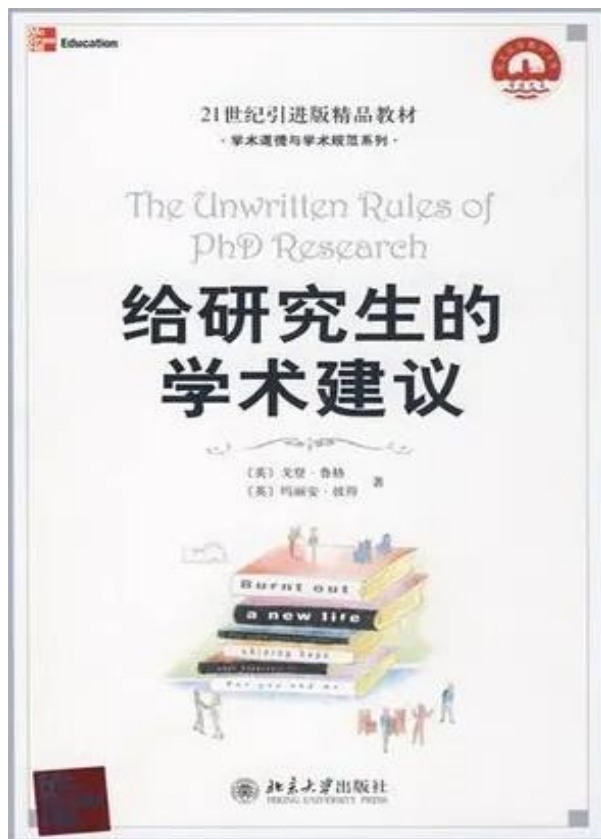
- The goal is to learn,
 - How to **read and understand** a scientific paper
 - How to **structure** data and results
 - How to **write** a manuscript (or at least parts of it)
 - How to engage into **team work**
- The objectives include,
 - The **methodology** of scientific reading & writing
 - The **habit of periodic summarization** of literature and results

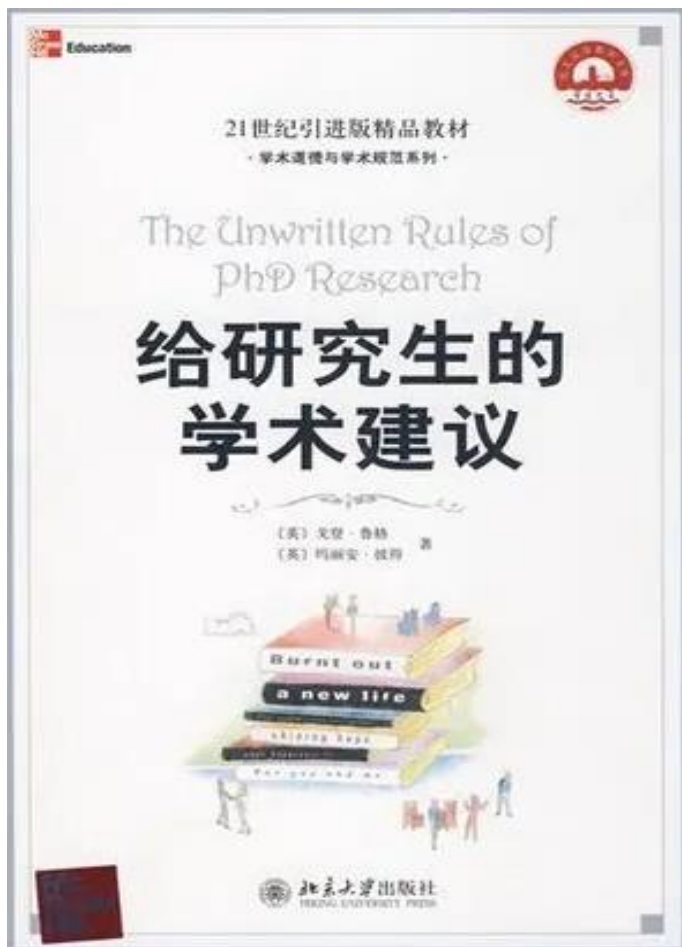
About this course (continued)

- 50-80-minute talk by tutor
- For each group
 - **Panel Discussion** (background, significance, main contents, ≥ 5 citations from SCI journals)
 - **Team Presentation** (background, ≥ 4 main sections, conclusion/perspective)
 - **Team Report** (Review style; 5000 words with ≥ 2 Figures)

- New paradigm for teaching scientific writing in STEM, Cell (2022) 47:631-634. (<https://doi.org/10.1016/j.tibs.2022.03.019>)
- Stanford Writing in the Sciences, <https://www.coursera.org/learn/sciwrite>
- MIT CommKits, <https://mitcommlab.mit.edu/find-comm-labs/>
- UCLA Writing workshop, <https://gwc.gsrc.ucla.edu/resources/writing-for-publication>
- Northeastern Univ Writing in STEM, <https://cssh.northeastern.edu/writingcenter/writing-resources/writing-in-stem/>

Learning materials: books





前言

研究生们毕业以后常常会发出这样的感叹：“为什么没有人早点告诉我这些呢？”有很多东西，如果早点得知，就可以少点困惑、失望、痛苦和泪水了。但是，在现实中，却没有人愿意将这些事情告诉你，或者写到教科书中去。

本书作者曾经花费大量的时间来帮助那些满怀求知欲的初学者。他经常是一边喝咖啡一边向他们解释学术研究规则。为了减少学生咖啡因的摄入，作者决定将这些技巧、规则等都写成书。书中将大体阐明学术界的基本技巧和规则，并介绍进行研究工作的一些细节问题。本书所关注的焦点是那些主流教科书所不屑于提及，而实际上却至关重要的问题，因为主流的教科书大多想当然地认为可以把这些问题留给读者的导师来解决。

如果你正在攻读博士或者是硕士学位，本书将帮助你尽量少走弯路，以做出最好的研究成果。同时，本书也将帮助你充分利用这些研究成果，将它们变成你的职业生涯和个人发展的重要组成部分。这样就可以避免以下情况出现：毕业的那一天，你拿着学位证书，却苦于不知道下一步该做些什么，这时候突然发现自己花费了多年时间却是在一个错误的方向上痛苦地爬行。

给研究生的学术建议

按照我们的经验，博士生通常会在两类问题上遇到麻烦。一类是，学术系统怎样运行，以及为什么这样运行之类的大问题。例如：学术界一些杰出人物的特殊经历和职业发展道路是怎样的？为什么学术文章的写作如此枯燥？为什么有的人博士还没有毕业就可以在非常好的院系获得讲师职位，而另外一些人在获得博士学位十年以后仍然要为找到一个工作而奋斗？一个好的院系的评价标准是什么？为什么？有的学生害怕问这些问题会显得很无知，更多学生则是因为过于关注与博士学位直接相关的问题，而没有去考虑得更加长远，当他们意识到的时候，一切都晚了。

另一类则是技巧层面的问题。有一些比较低层次的技术问题，通常被看得不是那么重要，而没有书谈及。这些学科内的技巧一般都是导师或者是讲师在平时传授的。这类问题从一些十分具体的信息（例如“我在文章的第一段中应当提到几条参考文献？”）到一般的经验法则（rules of thumb）（例如“我如何能够在没有刻苦阅读文献的情况下，对导师给我的题目有一个清晰而完整的认识？”）。这些特定的技巧以及答案会因学科的不同而不同，但是一旦你学到了这些技巧层面的基本概念，你马上就可以找到自己学科的诀窍所在，并很快学会它。

本书中每章会讨论对博士生非常重要的某方面知识。一些十分具体的问题，比如“怎样对待批评”是在许多章（如写作、陈述报告、答辩）都会讨论的问题。还有一些一般的主题（例如写作）则会成为每章的主题。每个章节都是从文字描述某个主题开始，都会通过一些例子和奇闻轶事来解释说明。文字描述是为了帮助你理解实际情况是怎样的，为什么事情会是这个样子的；奇闻轶事是为了说明那些潜在的要害，并帮助你记住它们。

- Intellectual skills
 - **Read and summarize** literature critically
 - **Identify and frame key problems**
- Practical skills
 - Obtain, record, and analyze data
 - **Present research** in a scientific manner
 - **Draft and revise** a research article
- Interpersonal/teamwork skills
 - **Communicate** in a scientific and respectful manner
 - **Evaluate** individual and team performance

- **Read, present & write** a research project
 - **Teamwork** within group
 - **Peer grading** during course
 - **Engage in discussions** during and after course
-
- Tips: learn **by practice**, and **from others**

- About the course
 - <https://github.com/popgenome/Writing2022/blob/main/README.md>
- Q & A, comment under the following link
 - <https://github.com/popgenome/Writing2022/blob/main/Q&A.md>

	Course	Assignment(s)
Week 1 (2/22)	Introductory talk + Scientific Reading	Prepare for group proposal
Week 2 (3/8)	Proposal talk (10-min talk + 10-min discussion)	
Week 3 (3/22)	Scientific Figure + Scientific Writing	
Week 4 (4/12)	Presentation I (20-min talk + 10-min Q&A)	
Week 5 (4/26)	Presentation II (20-min talk + 10-min Q&A)	Team essay
Week 6 (5/21)	End talk + Feedback	Peer review

- Presentation (30%)
 - **Peer grading** (20%), format 4%, background 4%, content 8%, presenting 4%
 - **Tutor grading** (10%), depending on the understanding
- Team report (40%)
 - **Peer grading** (20%), format 4%, typo 4%, content 8%, figure+table 4%
 - **Tutor grading** (20%), depending on the understanding
- Engagement (30%)
 - **Peer review + grading** (1% each)
 - **Q & A** during course (1% each)
 - Survey (5-10%)

1. 海底热泉与生命起源, the hot spring hypothesis for an origin of life
2. 物种演化, species and evolution
3. 基因编辑, gene editing
4. 细胞治疗, cell therapy
5. 逆转衰老, de-aging
6. 器官再生, organ regeneration
7. 意识起源, emergence of consciousness
8. 脑机接口, brain-computer interface
9. 人工智能, artificial intelligence
10. 远源嫁接, grafting
11. 天地生, desert soilization
12. 长生作物, perennial crop
13. Science of science (doi:10.1126/science.aao0185)

Presentation grading

19:49

23春季报告同学评议

请各位同学，对本组选题科研展示评分

*1. 被评议小组

*2. 你的姓名

*3. ppt制作：中英文是否统一、图表文字是否清晰、设计是否美观（满分10分）

110

12345678910

*4. 背景介绍：背景是否介绍清楚、选题意义是否点明（满分10分）

110

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23春季报告同学评议

4. 背景介绍：背景是否介绍清楚、选题意义是否点明（满分10分）

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5. 内容表述：是否图文并茂、逻辑是否清晰、结论是否合理（满分10分）

110

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6. 展示技巧：表达是否流畅、时间控制是否合理、回答问题是否切题（满分10分）

110

12345678910

提交

☆ 问卷星 提供技术支持 举报

Report grading

19:49

23春季综述同学评议

请各位同学，对本组选题文字综述评分

*1. 被评议小组

*2. 你的姓名

*3. 格式：中英文是否统一、标点符合使用是否得当、引文是否标准（满分10分）

110

12345678910

*4. 错字/词：发现一个扣一分（满分10分）

110

12345678910

23春季综述同学评议

4. 错字/词：发现一个扣一分（满分10分）

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12345678910

5. 内容：文献资料是否充分、逻辑是否清晰、结论是否合理（满分10分）

110

12345678910

6. 图表：是否能准确表达涵义、图表图注是否规范、是否有清楚的文字说明（满分10分）

110

12345678910

提交

☆ 问卷星 提供技术支持 举报

Peer grading (continued)

[illegible]

[illegible]

Part II

Assignments

Title↵

Name↵

Affiliation↵

↵

·Abstract↵

.Subtitle1↵

.Subtitle2↵

↵

·Conclusion/Perspective↵

.References↵

题目↵

姓名↵

部门↵

↵

·摘要↵

.小标题 1↵

.小标题 2↵

.结论与展望↵

.参考文献↵

1

2

3

4

5

6

Proposed Topic/Title of Research:↵

↵

—Genome assembly of a wild soybean accession from Heilongjiang Province.↵

↵

Background:↵

~~(Please provide background material that explains the motivation for and aims and objectives of your proposed study, outline the theoretical framework that forms the basis of your research, and specify the research question(s) you intend to investigate.)~~↵

↵

Soybean (*Glycine max*), an annual herb, is an important protein and oil source. ~~Historical Previous works evidence indicates suggesting~~ that cultivated soybean was introduced from north-eastern China approximately 6,2510 BP.^[1] Compared with domesticated crop cultivars, their wild relative species maintain a higher level of genetic diversity. Since wild species have been challenged in natural environments for thousands of years ~~and maintain a much higher level of genetic diversity~~, they represent important gene pools, especially for biotic and abiotic stress tolerance, for crop breeding. For example, wild germplasm have been extensively used in soybean breeding programs^[2-3], ~~which means north-eastern wild soybean is a valuable source for crop breeding~~.↵

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Questions?