Preliminary Steps in Writing a Scientific Manuscript

Overview

The writing process can be compared to an iceberg. A published article is just the tip of the iceberg, the part that is visible above water. The much larger part beneath the surface includes all of the planning, research, writing, and revisions involved. This session is about the practical steps you can take now to get started on your manuscript, even if you are not yet finished with your research.

Topics to be covered:

- Writing the hypothesis or purpose statement
- Keeping experimental records
- Selecting the data and the article format
- Selecting a journal
- Planning the writing process
- Making an outline
- Writing with discipline
- Using MD Anderson's resources

> *"No one was born writing scientific papers. Everyone has to learn how to do this, and making mistakes is part of the process."*
>
> —Sharon Roth Dent, PhD,
> Biochemistry & Molecular Biology

Writing the Hypothesis or Purpose Statement

Every scientific paper should include a statement that clearly explains why the study is being undertaken. Sometimes this statement is in the form of a **hypothesis statement** and sometimes in the form of a **purpose statement**. Good hypothesis and purpose statements establish the important link between a study's gap in knowledge and its conclusion.

Hypothesis Statements

A hypothesis is a scientific hunch, an educated guess, a testable prediction. A hypothesis-driven study and the article written about it are based on the central hypothesis of the research:

> We hypothesized that collagen XVIII expression correlates with serum endostatin levels in patients with non–small-cell lung cancer.

The objective of a research study is to test the hypothesis, to see whether the hunch is accurate:

> The study will test whether collagen XVIII expression correlates with serum endostatin levels in patients with non–small-cell lung cancer.

The data from the study either support the hypothesis or contradict it. In other words, the data reveal whether the hypothesis is valid or invalid.

Note that in a typical hypothesis statement with 2 verbs, the first verb (for example, **hypothesized** or **investigated)** is in the **past tense,** and the second verb is in the *present tense.* Also, the statement is phrased in the first person, using we or our.

> We **hypothesized** that collagen XVIII expression *correlates* with serum endostatin levels in patients with non–small-cell lung cancer.

Some studies have 1 central hypothesis plus 1 or more subhypotheses:

> We hypothesized that the use of erythromycin is associated with the risk of sudden death from cardiac causes and that this risk increases with the concurrent use of strong inhibitors of CYP3A.

Purpose Statements

A **purpose-driven study** is usually conducted to gather more information about a topic—for example, to characterize a rare disease, to determine the pharmacokinetic properties of an agent, to determine the genetic profile of an organism or tumor, or to describe a novel technique:

> We studied the systemic absorption and tissue distribution of indole-3-carbinol after oral administration to mice.

The purpose statement is based on the need for the study. Studies without a clear hypothesis statement must have a critical need for the information being sought:

> Studies in mice and cultured cells have shown that restoration of RECK expression inhibits tumor invasion, metastasis, and angiogenesis. *However, the clinical relevance of these findings remains to be fully documented.* Here we examined the expression of RECK and 1 of its targets, MMP-9, in colorectal cancer tissue.

A purpose-driven study is often 1 that is performed early in a larger project, before the researcher has enough information to form a strong hypothesis:

> The purpose of this study was to develop a cross-species genetic screen to identify negative regulators of Cdc42p in *Schizosaccharomyces pombe.*
>
> [Future studies will investigate the mechanisms by which Nrflpa, a novel negative regulator identified in this genetic screen, regulates Cdc42p function, subcellular localization, interactions with regulators/effectors, and/or expression levels.]

In such a study, an actual hypothesis statement would sound contrived, or awkward. Instead, it is the gap in knowledge that drives the study, with the objective of the study being to fill that gap.

> **Contrived:** We hypothesized that a cross-species genetic screen can be developed to identify negative regulators of Cdc42p in *S. pombe.*

Common Problems

A common problem in scientific manuscripts is the absence of a clear explanation of why a study was performed. Poor hypothesis statements often do not make clear the variables to be tested.

In the table below, the left column contains poorly written hypothesis statements, and the middle column illustrates how these statements could be improved. The final column contains conclusions. Note the similarity in wording between the hypothesis statements and the conclusions.

Poor hypothesis statements	**Good hypothesis statements**		**Good conclusions**
We used BLAST searches to study the sequences downstream from the TATA box in basal PolIII snRNA. [states method instead of why the sequences were examined or what the expected findings were]	Our hypothesis **was** that sequences downstream from the TATA box *regulate* the efficiency and specificity of basal PolIII snRNA transcription by influencing the assembly of TFIIB-α.	Our study **investigated** whether sequences downstream from the TATA box *regulate* the efficiency and specificity of basal PolIII snRNA transcription by influencing the assembly of TFIIB-α.	Nucleotides ___ to ___ downstream from the TATA box *regulate* the efficiency and specificity of basal PolIII snRNA transcription by influencing the assembly of TFIIB-α.
Actin assembly and its role in membrane fusion were studied. [does not say why]	We **hypothesized** that the actin assembly process *facilitates* phagosome/endosome aggregation before membrane fusion.	We **proposed** that the actin assembly process *facilitates* phagosome/endosome aggregation before membrane fusion.	The actin assembly process *facilitates* phagosome/endosome aggregation before membrane fusion.
We explored the relationship between hormonal factors and age at development of breast cancer. [vague; does not state how these factors may be related]	We **hypothesized** that earlier exposure to hormones or exposure to a higher level of hormones *is linked* to earlier development of breast cancer.	The purpose of our study **was** to determine whether earlier exposure to hormones or exposure to a higher level of hormones *is linked* to earlier development of breast cancer.	We **found** that earlier exposure to hormones but not exposure to a higher level of hormones *is linked* to earlier development of breast cancer.

Poor hypothesis statements	**Good hypothesis statements**		**Good conclusions**
We studied the effect of high-dose chemotherapy using X and Y plus autologous stem-cell transplantation on survival in patients with previously untreated multiple myeloma. [does not state hypothesized effect or comparison group]	We **hypothesized** that high-dose chemotherapy using X and Y followed by autologous stem-cell transplantation *improves* survival duration compared with conventional-dose chemotherapy using X, Y, and Z in patients with previously untreated multiple myeloma.	In this phase III trial, we **determined** whether high-dose chemotherapy using X and Y followed by autologous stem-cell transplantation *improves* survival duration compared with conventional-dose chemotherapy using X, Y, and Z in patients with previously untreated multiple myeloma.	We found that high-dose chemotherapy using X and Y followed by autologous stem-cell transplantation *improves* survival duration compared with conventional-dose chemotherapy using X, Y, and Z in patients with previously untreated multiple myeloma.

Articles about purpose-driven studies sometimes erroneously omit the purpose statement altogether and use background information, a method, a finding, or a conclusion instead. In the table below, the first column contains statements that might inappropriately appear in place of a purpose statement, the middle column contains acceptable purpose statements, and the final column contains conclusions. Again, notice the similarity in wording between the purpose statements and the conclusions.

Inappropriate substitutes for purpose statements	**Good purpose statements**	**Good conclusions**
Studies in animals have suggested that calcium may reduce the risk of colorectal cancer. However, results from epidemiologic studies of intake of calcium or dairy foods and colorectal cancer risk have been inconclusive. [implies gap in knowledge but does not state purpose of study]	Our goal was to identify any associations between the consumption of dairy foods and calcium and colorectal cancer risk in a pooled analysis of 10 cohort studies from North America and Europe.	Higher consumption of milk and calcium is associated with a lower risk of colorectal cancer.

Inappropriate substitutes for purpose statements	Good purpose statements	Good conclusions
We performed Monte Carlo simulations with electron intraoperative radiotherapy cones of various internal radii, lengths, and materials irradiated by available electron beam energies. [states how the study was done but not why]	This study was performed to optimize the geometry of the ring inside the electron intraoperative radiotherapy cone (EIORC) so that its effects on the extent of the treatment volume are minimal.	The optimal ring position is about 10 cm from the bottom of the EIORC, regardless of the EIORC material, geometry, or electron energy.

Together, the hypothesis/purpose and conclusion statements represent a paper at its most fundamental level, and together, they should contain all the information needed for the title.

(After you have completed your research, try to draft a 1-sentence conclusion, relating it to the hypothesis you have been examining.)

Keeping your hypothesis or purpose statement in mind while you research and write your paper will help you stay focused

- By clarifying the message of your paper.
- By limiting the references and data you assemble to only what is relevant.

Activity 1

Writing Your Hypothesis or Purpose Statement

Write a draft of your hypothesis statement or purpose statement. Some of these statements will be reviewed in class. Your statement will be used later in the workshop. After the workshop, keep it where you can easily refer to it throughout your research and as you begin to write your paper.

Selecting the Data and the Article Format

Before you begin writing, consider your data and what constitutes a "publishable unit," and decide on the best format for your data.

Your data will determine the "story" that your article tells—how complete it is and how easy it is to understand. At some point, you will need to decide whether you have enough information for an article, too much, or not enough.

> *"I try to be concise in all sections of a manuscript. The most important decision is what data to show, and then I build a story around them. I try to limit the information to what's necessary to make my point."*
>
> —Francisco J. Esteva, MD, PhD, Breast Medical Oncology

Choosing What Data to Use

To decide how best to use the data that you have collected, consider these 3 questions:

1. How much information is enough?

Your data should

- Tell the whole story
- Prove or disprove your hypothesis

2. How much information is too much?

You have too much information when you have

- Data that are not necessary to tell your story
- Data that answer multiple questions

If you have **extra or unnecessary data**, you will need to cut some of this information out.

If your data answer **multiple questions,** you may need to write more than 1 paper or choose to report on only the most important research question. For example,

- You may have several hypotheses.
- You may have 1 hypothesis that builds on another.
- There might be a portion of the paper (your research) that you should publish first before reporting on the study as a whole, such as a novel method or a new cell line or animal model.

However, if your data do not warrant it, do not try to create several papers from a single study. This is sometimes called "salami science."

> *"I try to limit the experiments presented to those that form a linear and logical thought process. In other words, to have it seem that each experiment undertaken was a natural consequence of the prior experiment presented (even if the order in which the experiments were conducted in the lab was different)."*
>
> —Pierre D. McCrea, PhD, Biochemistry & Molecular Biology

3. When is your information not enough?

You lack sufficient information when there are not enough data to support your conclusions. If that is the case, you probably need to do more research.

Types of Articles

After you decide that you have the correct amount of information for 1 paper, you are ready to consider the type of article to write.

Research Articles

- Are full reports of original investigations
- Typically include Introduction, Methods, Results, and Discussion sections
- Usually have no strict limits on article length or number of references

Brief Communications and Technical Notes

- Are reports of important preliminary findings or new techniques
- Are shorter versions of research articles
- Are limited in length, number of references, and number of illustrations

Letters to the Editor

- May present research findings
- Usually comment on journal contents or present progress reports or updates on published work

Reviews

- Summarize the current status of a given topic
- Generally do not report original data

Case Reports

- Describe novel, interesting, or rare clinical cases
- Typically consist of a brief introduction followed by a description of the case and a brief discussion (the format varies from journal to journal, however)

After you know the type of article you are going to write, you are ready to select the journal.

Selecting a Journal

Before you begin writing, it helps to select the journal to which you will submit your article. Choosing a journal before you write

- Helps you write for that particular journal's audience
- Allows you to organize your article for that particular journal

When you are considering different journals, ask yourself these questions:

- How important is my research in this field?
- Are my results novel?

- Do my results overturn current thought; that is, do they prove or disprove what is generally accepted in the field?
- Who is my target audience?

> *"I continually place my work in the context of the evolving literature on the subject of my research."*
>
> —William Plunkett, PhD, Experimental Therapeutics

Identifying Your Audience

An important consideration in choosing a journal is identifying your audience. Realistically, who is your audience? Who will *need* to know the answer to your research question?

For example, if your research is about the X gene in mice, who would your audience be?

All molecular biologists studying the X gene in mice?

All molecular biologists studying the X gene?

All molecular biologists?

All clinicians studying the disease produced by the X gene?

All clinicians?

In other words, should you target a *general circulation* (wide audience) journal or a *specialty* (narrow audience) journal?

> *"I never start anything without thinking of the audience. Who is going to read this document? I think inexperienced people… are very experimentally oriented: 'Here are my experiments. Here's what I want to say….' I tend to look at [my papers] as something that I'm providing to the community."*
>
> —William H. Klein, PhD, Biochemistry & Molecular Biology

Choosing a Journal Type

Knowing your target audience will help you choose a journal. There are 2 main categories of medical/science journals:

- General circulation journals
- Specialty and subspecialty journals

General Circulation Journals

Characteristics:

- Include *The New England Journal of Medicine*, *Science*, and *Nature*
- Are designed for broad audiences
- Tend to publish groundbreaking findings with far-ranging implications
- Accept only a small fraction of articles submitted for publication. (For example, *Science* sends out for review only about 35% of submitted manuscripts at the initial screening stage, and the percentage actually accepted for publication is much smaller.)

Submissions:

- Are usually screened at the journal offices for impact, novelty, timeliness, and interest to the journal's readers
- Are sent for peer review if they meet the screening criteria
- Are returned promptly if they do not meet the screening criteria
- Should be accompanied by a letter of submission explaining how the article meets the journal's criteria

Specialty and Subspecialty Journals

Characteristics:

- Are designed for readers in specialized fields
- Include such journals as *Journal of Biological Chemistry*, *Molecular Carcinogenesis*, *Cancer Research*, *Genes and Development*, *Journal of Clinical Oncology*, *Annals of Surgical Oncology*, and *Plastic and Reconstructive Surgery*
- Accept articles of narrow focus that would be inappropriate for general circulation journals

Submissions:

- Are screened at the journal offices to make sure they fall within the scope of the journal
- Are usually sent out for peer review
- Are more likely to be accepted for publication than manuscripts submitted to general circulation journals

Choosing a Particular Journal

Learn as much as you can about the journal you are considering by checking a few issues of the journal and by reading the journal's instructions to authors. Instructions to authors can be found in the journal, on the journal's Web site, and at www.mco.edu/lib/instr/libinsta.html. You can also call the journal office if you have specific questions.

Here are additional characteristics to consider in selecting your target journal:

- Range of topics covered, as described in the instructions to authors
- Types of articles in the journal
- Frequency of publication
- Rejection rate
- Review time
- Possibility a journal will publish your particular article
- Journal ranking (impact factor)

The impact factor is a measure of how "important" a journal is on the basis of how many times articles in the journal get cited in other journals. *Journal Citation Reports* lists impact factors by field (biochemistry and molecular biology, for example). However, the rankings may be skewed by the types of articles a journal publishes. For instance, a review journal may have a high impact factor because a few of its reviews are widely cited, but in this case, the high impact factor may not reflect the journal's true importance in the field.

The Institute for Scientific Information then takes these impact factors and ranks the journals within their specialty areas. The rankings below are of the top 15 journals in the oncology category in 2019:

	Title	Impact Factor
1.	*CA: A Cancer Journal for Clinicians*	292.278
2.	*Nature Reviews Clinical Oncology*	53.276
3.	*Nature Review Cancer*	53.030
4.	*Lancet Oncology*	33.752
5.	*Journal of Clinical Oncology*	32.956
6.	*Cancer Discovery*	29.497
7.	*Cancer Cell*	26.602
8.	*JAMA Oncology*	24.799
9.	*Annals of Oncology*	18.274
10.	*Molecular Cancer*	15.302
11.	*Journal of Thoracic Oncology*	13.357
12.	*Journal of the National Cancer Institute*	11.577
13.	*Trends in Cancer*	11.093
14.	*Seminars in Cancer Biology*	11.090
15.	*Journal of Hematology & Oncology*	11.059

Once you have a target journal in mind, ask your colleagues for advice. They can often tell you if your research has a realistic chance of being published by the journal you are considering.

If you are considering a prestigious, high-impact journal, ask yourself whether you can afford a possible delay in publication if your paper is sent out for review but ultimately rejected. Also ask yourself whether it is more important to have your paper published in that journal or simply to have your paper published. A rejection will mean that you must reformat the article for a new journal and go through the review process again.

Finally, if you have any remaining questions about a particular journal, contact the journal office. Journal editors are sometimes willing to discuss the suitability of a paper before it is submitted.

> *"Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time."*
>
> —Thomas Edison

Activity 2

Selecting a Journal

How much do you know about your target journal? When you are considering a target journal, there are several things to think about. What are its pros and cons? Do you think your choice is realistic? Would you consider a more prestigious journal? Why or why not? Are you prepared for the delay if your article is rejected?

Instructions: Think about the questions above, and write down the pros and cons that you already know about your first and second journal choices and the reasons you are targeting these journals. Refer to the bulleted list on page 2-21.

Target journal #1:

Pros:

Cons:

Reasons for choosing:

Target journal #2:

Pros:

Cons:

Reasons for choosing:

Planning the Writing Process

Before you begin writing your paper, a certain amount of planning is necessary, including talking with your PI, deciding on authorship, drafting a manuscript plan, identifying responsibilities, and collecting items for your paper that you already have. Planning your time carefully is also important to help you and your co-authors meet your deadlines.

Talking with Your PI

Before you begin writing your paper, talk to your PI about

- the role that he or she will play
- the writing process and schedule
- the expectations for first author and co-authors
- the content and basic structure of the paper (the outline)

A planning meeting can help you make sure that you and your PI agree on the most important aspects of the paper before you begin to write. It can save both of you a lot of trouble later on.

Below are typical questions that you might ask your PI:

1. To get started on my paper, I've written a hypothesis statement and conclusion. Do you think they are accurate?
2. It seems to me that the target audience for our study is ____. Should I write the article with this group in mind?
3. I think our research is best suited for publication in _____, _____, or _____ as a (research article or brief communication, etc.). Do you have a particular journal in mind for submission of the manuscript?

4. I assume that I will be the first author and you will be the last. Who else should be co-authors and in what order? What will the responsibilities of each author be? Is there anyone who should be listed in the Acknowledgments?
5. Here is a list of experiments (or results) that I plan to include in the article. Do you think my paper should include this much of my work? Do I have enough for more than one paper?
6. When do you want the first draft completed? Can I show you each section as I complete it? (I might not write them in order.)
7. Would you like to meet regularly to discuss my progress, or should I just contact you when I need to talk about something?

At a later time, you might want to tailor these questions for your own situation.

> *"A good mentor to critique your writing is invaluable."*
>
> —Stanley R. Hamilton, MD, Pathology

Deciding on Authorship

One of your first tasks is to determine the authors of the article and what role each author will play. The following are the 3 basic criteria that must be met to qualify as an author:

- An author should have generated at least a part of the intellectual content of a paper, either in conceiving or designing the study or in collecting reported data.
- An author should have taken part in writing the paper, reviewing it, or revising its intellectual content.
- An author should be able to defend publicly in the scientific community all of the intellectual content of the paper.

Authorship is discussed in more detail in the chapter "Ethical Issues in Scientific Publishing."

> *"I would encourage anyone who is a first author to write the first draft of a manuscript himself. That is the only way to learn how to do it. Don't let your supervisor do it… My advisor always made me write the first draft, and it was usually terrible. But that's how I learned to write, by comparing my version with his."*
>
> —Mien-Chie Hung, PhD, Molecular & Cellular Oncology

Drafting a Manuscript Proposal

A useful planning tool for the writing project is a form that allows you to identify co-authors and their roles and to document and communicate decisions made during the writing and publication process. Robert M. Chamberlain, PhD, Department of Epidemiology, The University of Texas MD Anderson Cancer Center, devised just such a proposal and stated its purpose as follows:

> The Manuscript Proposal form is meant to be drafted and circulated among all authors, edited, and updated as the manuscript progresses. It is usually drafted by the author who intends to be the first author. Mentors can use the form to assign papers to trainees. The form can be the basis for reaching consensus in meetings of the authors. Having agreement among the authors can help avoid arguments later. When trainees are among the authors, it helps ensure that they retain their role on the manuscript, even when it is finished and submitted after the trainee has left.

The form that follows is adapted from Dr. Chamberlain's. You may want to tailor it for your own situation, whether or not you actually use it formally.

Manuscript Proposal

This form is intended to be filled out by the first author and corresponding author (if not the first author) of a paper, circulated among all co-authors, and updated as necessary. It will help ensure that all co-authors know and agree with the information contained in it.

Person proposing paper:_____ Date:_____

Working title of article:_____

Hypothesis or research statement:_____

_____

Principal investigator and laboratory: _____

Authors in the order they will be listed in the article: 1._____

2._____ 3._____ 4._____

5._____ 6._____ 7._____

Responsibilities of authors:_____

_____

_____

People to acknowledge:_____

_____

Potential journals:_____

Date first draft to be completed:_____

Date final paper to be submitted:_____

Special needs, issues, or concerns:_____

Principal investigator's approval:_____ Date:_____

This form was adapted from a form created by Robert M. Chamberlain, PhD, and is used with his permission.

Identifying Responsibilities

Whether you write your article alone or with others, there is a long list of tasks to complete. Ideally, these tasks are shared among co-authors, but most will fall to the first author and corresponding author. (In some cases, the corresponding author is also the first author.) To ensure that nothing is overlooked, the first author and corresponding author should agree on the division of responsibilities at the beginning of the project. Then all co-authors should be kept informed and involved throughout. A planning meeting can help you make sure that you and your co-authors agree on the most important aspects of the paper and the responsibilities before you begin to write. It can save you a lot of trouble later on.

Here are the major tasks involved in writing and publishing a scientific article:

- Meet with co-authors to determine roles, publishing strategy, and deadlines.
- Collect the material you already have. (See list on page 2-26.)
- Organize your lab notes, note cards, and other materials.
- List the experiments (or results) that will be discussed in the paper.
- List the names of the materials used and their suppliers.
- Check the journal's author instructions to make sure your paper meets all the criteria.
- Write out the hypothesis or purpose statement and conclusion of your study.
- Plan the structure (outline) of the manuscript.
- Create the figures and write the legends.
- Create the tables.
- Write the title page and acknowledgments section.
- Write the manuscript. The parts of a manuscript can be written in any order.
- Write the Introduction section.
- Write the Materials and Methods section.
- Write the Results section.
- Work with a statistician to ensure that the statistics in your paper are accurate.
- Write the Discussion section.
- Write the Abstract and make sure it is in the format required by the journal.

- Ensure that the appropriate literature is cited in the manuscript.
- Make sure that all references in the text are cited in the reference list and vice versa, and make sure that the reference list and citations are formatted consistently and according to the journal's style requirements.
- Cross-check the data in the Abstract, text, figures, and tables.
- Have a colleague review your draft.
- Provide early drafts of the manuscript to co-authors for review, and incorporate their suggestions.
- Have the manuscript edited.
- Ensure that all co-authors review the final draft, including the latest figures and tables.
- Ensure that any changes made to the final draft during review are communicated to co-authors.
- Obtain written permission from scientists listed in the acknowledgments and for citing others' unpublished data.
- Obtain written permission to use previously published material.
- Prepare submission package (cover letter, manuscript, figures, suggestions of reviewers to request or avoid, etc.).
- Obtain signatures on copyright transfer agreement.
- Submit the manuscript to the journal.
- Communicate with the journal office (if necessary).
- Make sure any negotiations about the manuscript or its publication are communicated to all co-authors.
- If relevant, make the decision about whether to revise and resubmit the manuscript to the same journal or to a different one.
- Address comments from the journal's reviewers.
- Resubmit the revised manuscript.
- Pay for fees and reprints.
- Proofread page proofs.
- Distribute reprints!

The corresponding author coordinates the completion and submission of the manuscript and serves as the sole spokesperson for the article. He or she handles all communications about the article--with the journal office, publisher, and readers--and represents the interests of all the other authors. The staff of many journals will refuse to discuss a manuscript with anyone except the corresponding author.

Collecting the Material You Already Have

Another task you can complete before you begin to write is to collect the material that you already have:

- Lab notes
- Literature gathered
- Hypothesis or purpose statement
- Conclusion
- Methods section
- Tables and figures
- Names of materials used and their suppliers
- Author instructions
- List of co-authors with e-mail addresses and phone and fax numbers
- Acknowledgments
- References
- Poster presentations
- Slide presentations
- Outline of paper

Planning Your Time

A schedule for writing your paper will help you stay focused and reassure your co-authors. One way to plan a schedule is to estimate how much time you will need to complete the remaining steps, many of which are listed under "Identifying Responsibilities," and then multiply it by 2 or 3. For instance, if you think that a particular task will take 3 hours to do, multiply that amount to be more realistic. Thus, 3 hours could really mean 6 or 9 hours, depending on how experienced you are and whether you are collaborating with other authors.

Another way to plan your time is to decide on a date for submitting your paper and work backwards. For example, if you give yourself 2 months to plan and write your paper from start to finish, you might mark a date on the calendar 3 weeks before the submission date: 1 week for your co-authors to review the final version, a couple of days to make changes based on their comments, a week or 2 for an editor to edit the paper, a few days to make corrections, a few days for final approval by your co-authors, and a day to get the paper e-mailed or mailed to the journal.

For example:

March

S	M	T	W	T	F	S
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

April

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

April 30 — Submit paper to journal
April 25–29 — Get final approval from co-authors
April 23–24 — Make corrections suggested by editor
April 15–22 — Have paper edited
April 10–14 — Make changes suggested by co-authors
April 3–9 — Have co-authors review paper

Continue working backward on the calendar until you reach your starting point, and then adjust your schedule so that you feel sure you can meet all your deadlines.

Making an Outline

Writing an outline will help you organize your thoughts and get something down on paper, as well as communicate better with your co-authors.

An outline is simply the main points of your paper in a logical order, a road map of sorts.

> *"I generally think a lot in outline form. I develop an outline as a skeleton, and then I put the meat on the bones as I go along."*
>
> —Jeffrey N. Myers, MD, PhD, Head & Neck Surgery

The following are tips for writing an outline:

- First write down as many main ideas (hypothesis, materials, experiments, related studies, etc.) as you can think of to include in your paper. Then arrange the items in the order you think they will appear in the paper.
- Write down short phrases and put them in 1 of the 4 main sections of the paper (Introduction, Methods, Results, or Discussion).
- Include notes to yourself or additional thoughts as they come to you (for example, "Include explanation of article by Smith et al. here.").

- Do not worry about the format of your outline; you are the only one who has to be able to follow it.

Here is a sample outline on a basic science topic—really just a list of things to mention or describe in the paper and notes to yourself.

X Gene Expression Required for A and Angiogenesis

Introduction

- Process A is essential for angiogenesis and so may be target for cancer therapy
- Johnson & colleagues' original study of process A in 3 cell lines
- Lei et al. confirmed their conclusions in some cell lines but not others
- We think it depends on whether cells express X gene (cite AACR abstract)

Materials and Methods

- Sources of cell lines (ATCC, Manassas, VA, for all—except WRDCELL, which we got from Tom at Baylor)
- PCR protocols, primers (did we buy control or make it?—ask Margaret)
- In situ hybridization conditions
- Statistics (ask John the statistician to write that)

Results

- Use all figures from last departmental presentation except gene map
- Table of expression levels in all cell lines
- Best in situs

Discussion

- Conclusion: X gene expression is necessary for the A process
- How our study differed from Johnson and why it supports Lei et al.
- Possible implications for cancer therapy
- But we need to test this in tumor samples, which we are already doing

Here is a second example:

Introduction

- Osteoporosis as a public health problem
- Genetic factors involved
- High-bone-mass genetic disorder linked to 11q12–13
- Low-bone-mass genetic disorder (osteoporosis-pseudoglioma) linked to 11q12–13 and *LRP5* (involved in Wnt signaling)
- We hypothesize that high bone mass and *LRP5* are also linked

Methods

- Subjects—20 members of one kindred (redraw kindred with new kindred-drawing program): medical histories, bone-density measurements, and blood and urine samples collected
- Bone-density measurements (ask John the model number of the densitometer)
- Biochemical evaluation (list all serum and urinary proteins studied; need to get normal ranges)
- Genetic studies (11q marker analysis; don't forget to mention controls)
- In vitro biochemical studies (transfection of NIH3T3 cells with wild-type or mutant *LRP5* and a transcription factor activated by Wnt)

Results (base on figures and tables I used in dept. presentation last month)

- Identification of the kindreds
    - Figure 1 (ask Shannon if we have a better photo of mandible)
- Bone density
    - Table 1 (include subject who died?) & Figure 2 (redraw with new program)
- Biochemical findings
    - Table 2
- Point mutation in *LRP5*
    - Figure 2 & Figure 3 (add homology diagram)
- Molecular studies
    - Table 2 & Figure 4

Discussion

- Answer to hypothesis: Gain-of-function mutation in *LRP5* causes autosomal dominant disorder with high bone density, torus palatinus, wide and deep mandible
- Possible model
- Little et al. study
- Possible diagnosis by genetic test
- Role of LRP5 protein in osteoporosis?

Writing with Discipline

Writing is a difficult process for most people. But there are things you can do to make it easier, more efficient, and more pleasant.

The following are some habits of successful writers.

Make a schedule.

- Create a personal schedule for collecting background information and for writing.
- Plan your time carefully so that you can comfortably meet your deadlines.
- Do not plan to write the entire paper in 1 sitting.
- Allow time to put away a completed section or draft manuscript for a few days before reading it again.

> *"It's important to not try to do too much at once. You're not going to sit down and write the whole paper in one day. Conquer it in little sections."*
>
> —Jeffrey N. Myers, MD, PhD, Head & Neck Surgery

Create a comfortable environment.

- Make sure your writing area is quiet and comfortable and that you have all the research resources at hand when you start.
- Take regular breaks to relax, stretch your legs, and clear your mind.

Establish a routine.

- Make the time to write, and make writing a high priority to prevent distractions. Whenever possible, do not answer the phone or e-mail while you are writing: concentrate only on the task at hand.
- Develop a "ritual" to improve your workflow when writing; for example, always write at the same time every day, no matter what, or always finish a section before you stop.
- Pick a time that works for you, and set aside a block of time each day for writing.
- Each time you write, set a specific goal for how much to write.

> *"To be effective, I have to have at least a reasonable chunk of time to work with. I can't write manuscripts with a series of small fragments of time, write a few paragraphs of the paper, see 10 patients, dictate their notes, write another paragraph or think about it, and see five more patients."*
>
> —Michael J. Fisch, MD, MPH,
> Palliative Care & Rehabilitation Medicine

Make the writing project as easy as possible.

- Remember that you can start writing certain parts of your paper long before you complete your research.
- Start writing whatever section is the easiest for you.
- Write in chunks. Don't think that you have to write the paper from the beginning to the end.

> *"When I am stuck, I start with something that does not require mental energy. For example, if I'm writing a paper, I write methods when I'm stuck. This process is time-consuming, not thought-consuming."*
>
> —Gary E. Gallick, PhD, Cancer Biology

- Always write down ideas when you think of them, and keep your notes where you can easily find them. Keeping a small notebook in your pocket is one way to do this.
- Write notes at the end of each writing session to remind yourself where to start writing next time or of other tasks that you need to do.

> *"Writing is easy. All you have to do is stare at a blank piece of paper until drops of blood form on your forehead."*
>
> —Gene Fowler

Using MD Anderson's Resources

Be sure to take advantage of all the resources available to you as a writer at MD Anderson:

- Mentors
- Other faculty
- Other trainees
- Research Medical Library (classes)
- Research Medical Library
  Phone: 713-792-2282
  Email: RML-Editing@mdanderson.org
  www.mdanderson.org/library/

> *"Editing your own work is like removing your own tonsils—possible but painful."*
>
> —Anonymous

Conclusion

Remember the core message of this lesson: There are many things you can start doing now to get ready to write your next paper.

5-Stage Writing Process & Time Allowances:

Worrying	15%
Planning	10%
Writing	25%
Revising	45%
Proofreading	5%

—Michael Adelstein *(A Writer's Almanac)*

> *"However great a man's natural talent may be, the act of writing cannot be learned all at once."*
>
> —Jean Jacques Rousseau