

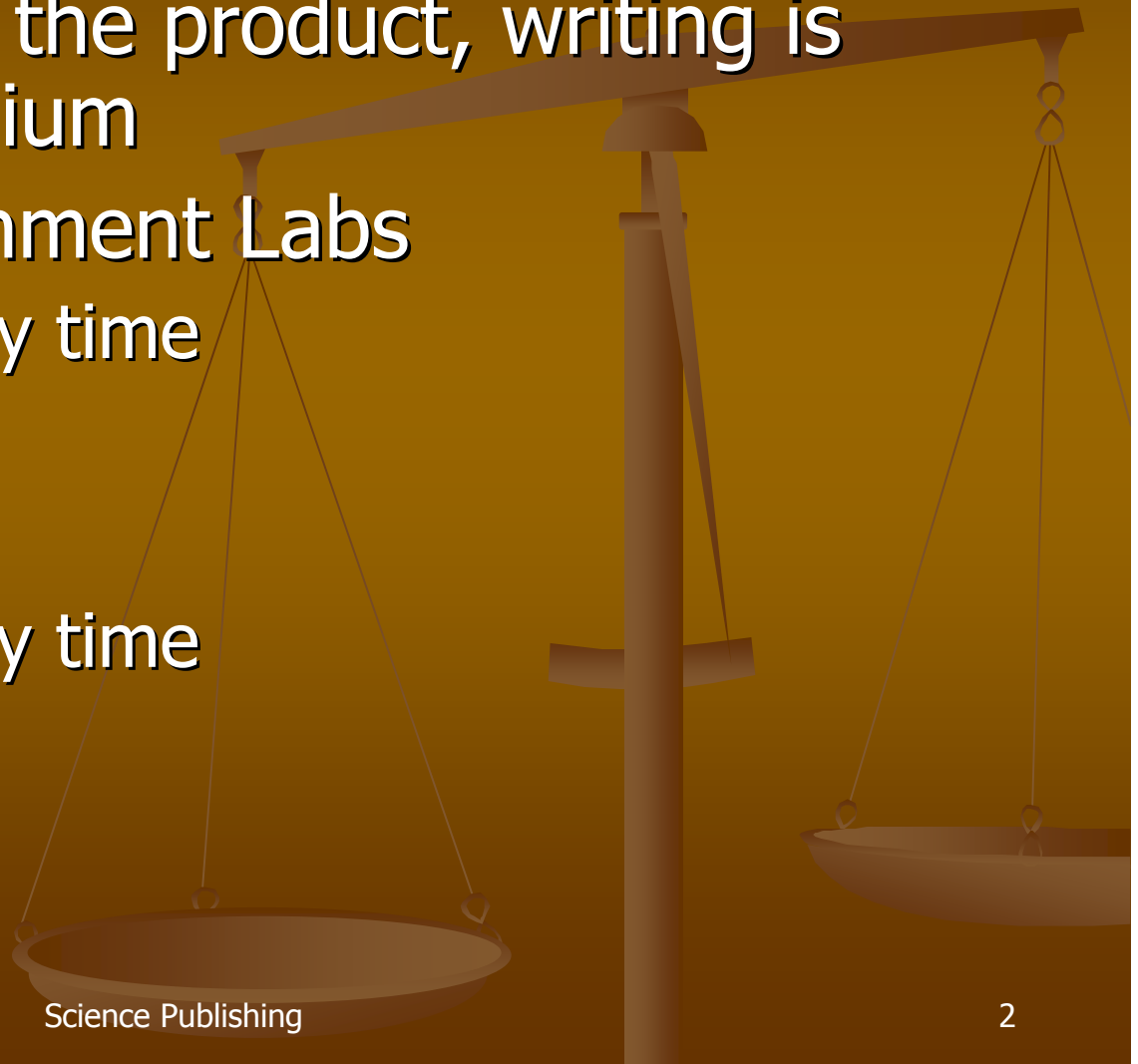
# Publishing in the Physical and Biological Sciences



Steve Turley  
October 31, 2006

# What, Scientists Write?

- When ideas are the product, writing is usually the medium
- Industry/Government Labs
  - 20%-30% of my time
  - Examples
- University
  - 30%-40% of my time
  - Examples



# Kinds of Scientific Writing

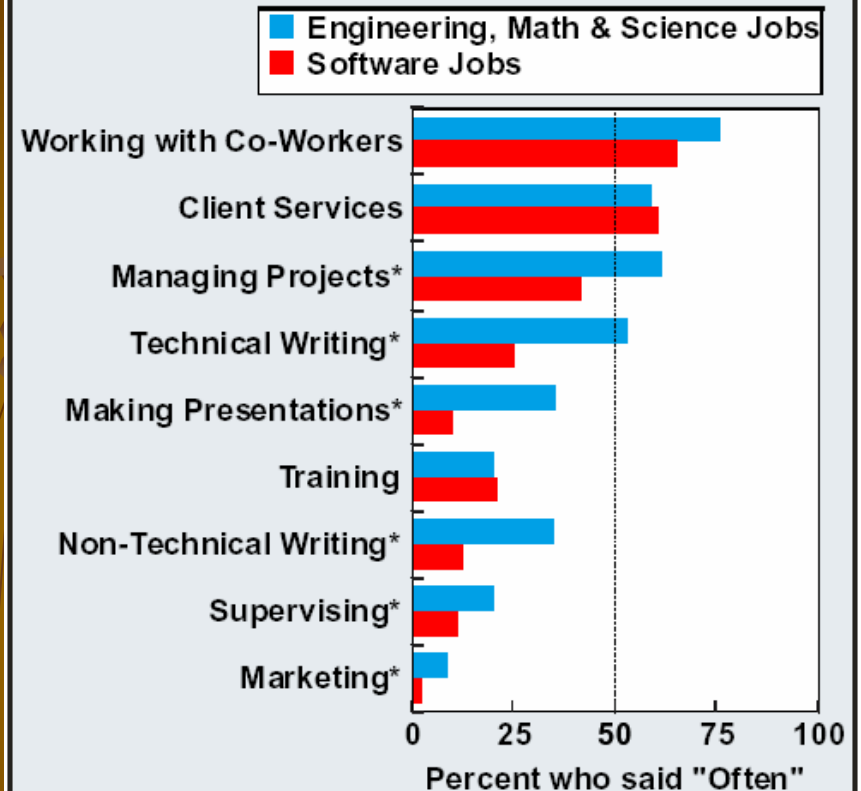
- Technical Articles (Colleagues)
  - Letters
  - Archival Journals
  - Review Articles
  - Reports
- Popular Writing (Public)
  - Textbooks
  - Public Information
- Persuasive Writing (Sponsors)
  - Grant proposals
  - Applying to graduate school
- Administrative Writing



# SME Job Activities

- More than 50% of scientists often do technical writing as part of their job
- More than 30% of scientists often do non-technical writing as part of their job.

Figure 3. Time Spent on Job Activities by Physics Bachelors 5 to 8 Years After Graduation

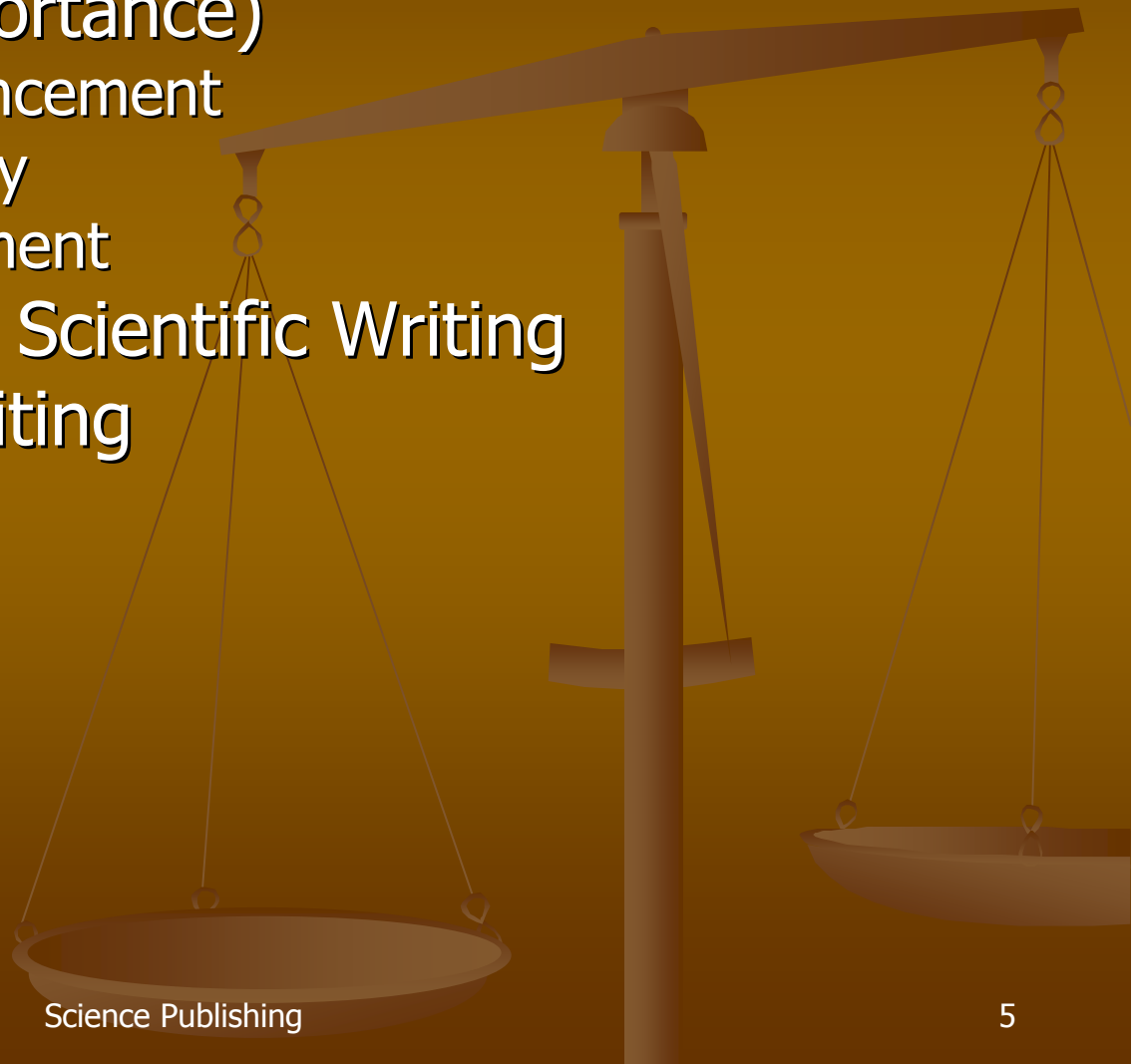


These data reflect the percentage who chose 4 or 5 on a 5-point scale where 1 = none and 5 = extensive. Based on physics bachelors with no additional degrees who are not teachers or primarily students.

\*Differences between the two fields of employment are significant at  $\alpha \leq .05$ .

# Outline

- Why Publish (Importance)
  - Professional advancement
  - Moral responsibility
  - Personal development
- Unique Aspects of Scientific Writing
- Approaches to Writing
- Quality Writing
  - Audience
  - Clarity
  - Voice
  - Interest



# Professional Importance

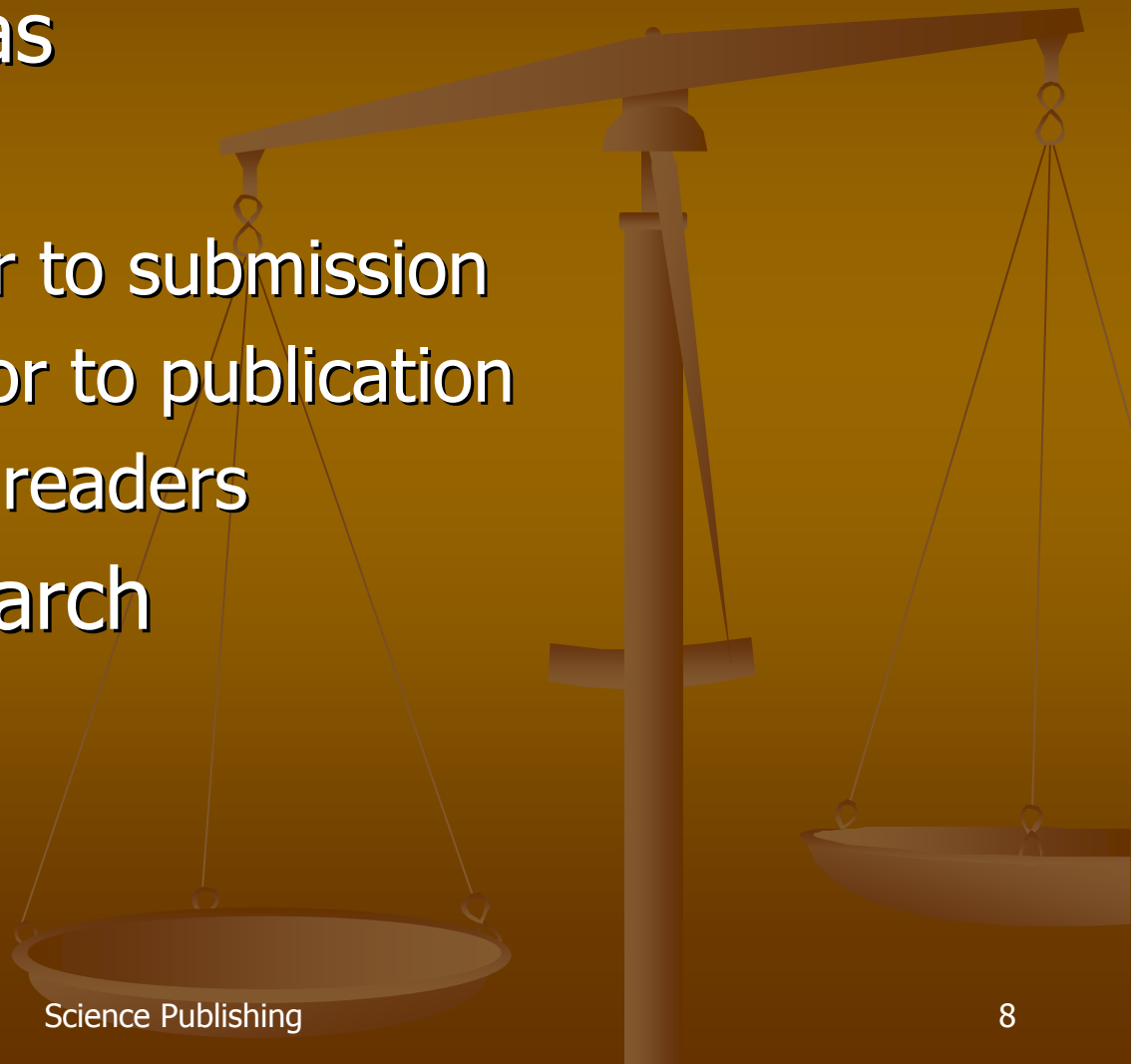
- Develop reputation
- Contact with others doing similar work
- Applying for jobs, fellowships, and graduate school
- Promotion
- Salary
- Documentation of accomplishments

# Moral Responsibility

- Stewardship of resources
- Support of others
  - Government
  - University
- Our ideas are built on those of others
- Scriptural imperative to “publish with the voice of thanksgiving, and tell of all thy wondrous works.” (Psalms 26:7)

# Personal Development

- Formalizing ideas
- Reviews
  - Colleagues prior to submission
  - Peer review prior to publication
  - Response from readers
- Organizing research
  - Milestones
  - Benchmarks



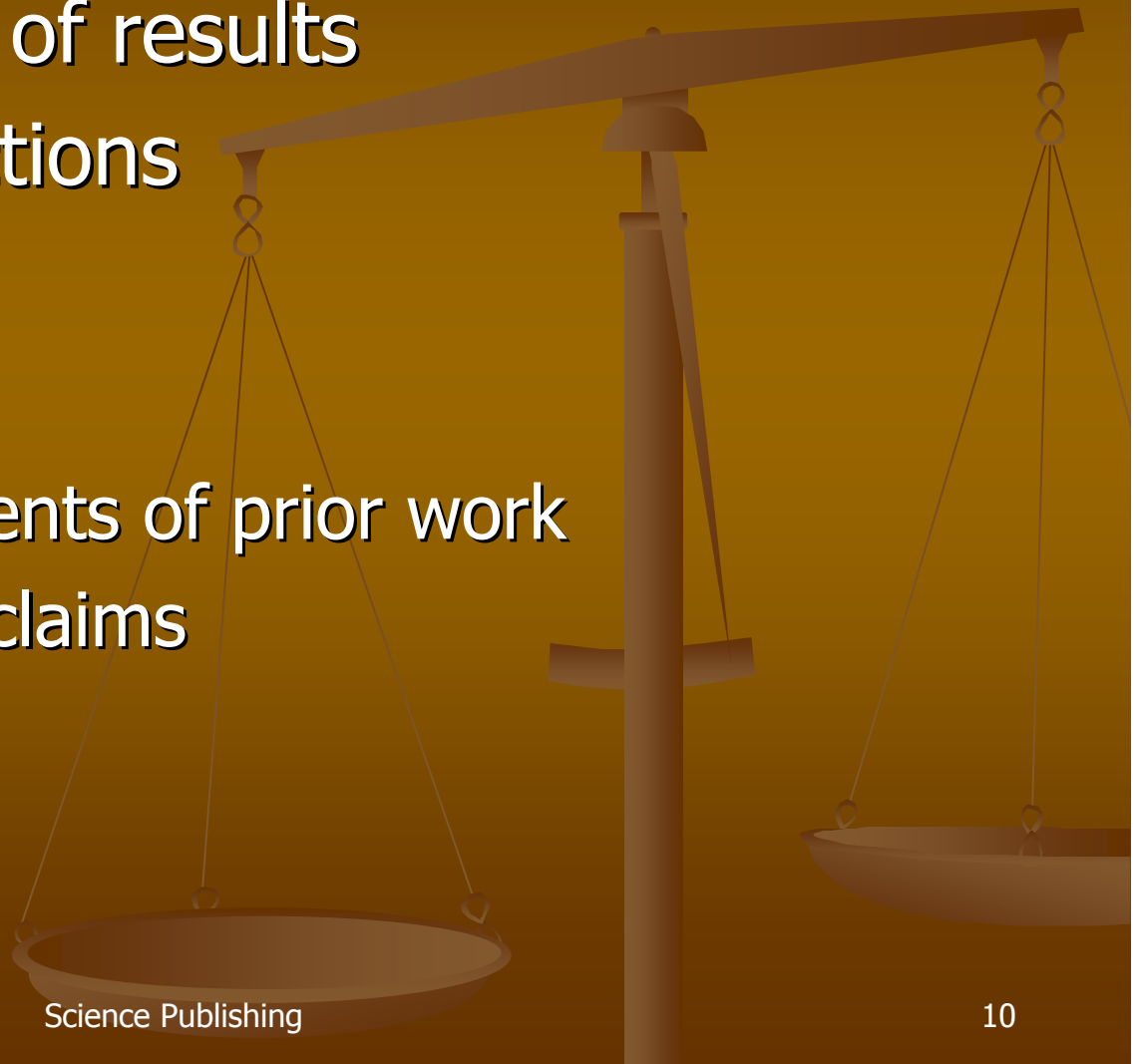


# Plus...it's fun!

- Concluding a job well done
- Sharing the joys in our discoveries with others
- Chronicle of our professional journeys
- Fun to see your work and name in print
- Examples
  - Running across University Scholar project in library
  - PhD research: prodding theory
  - Reviewing old papers for rank advancement

# Unique Aspects of Scientific Publishing

- Communication of results
- Avoiding distractions
- Style
- References
  - Acknowledgements of prior work
  - Justification of claims



# Communication of Results

- Helping your reader find your article
  - Title
    - Names
    - Authorship
  - Abstract
  - Keywords
- Highlight critical points
- Center discussion on unique data or conclusions
- Be concise and precise

# Some Example Titles

- Laser-Cluster Interaction: X-Ray Production by Short Laser Pulses
- Real-Time and Background-Free Detection of Nanoscale Particles
- Coherent Optical Photons from Shock Waves in Crystals
- Proposed Experiments to Probe the Non-Abelian  $\nu=5/2$  Quantum Hall State

Phys. Rev. Lett. 96 [13 Jan 2006]

# Note on Names

- Searching for other articles by you
- Where possible, be consistent
  - Initials or full name
  - Use of first or middle name
  - Use of middle initial
- How common is your name?
- Decide now
- Special challenge faced by women

# Authorship



## ■ Custom

- Include as authors all who contributed substantially to the work
- One person write manuscript
- Others review

## ■ Order

- Principle contributor first
- Alphabetical
- Senior author first
- Senior author last

# Example Abstract

- We introduce a background-free real-time detection scheme capable of recognizing low-index nanoparticles such as single viruses in water. The method is based on interferometrically measuring the electromagnetic field amplitude of the scattered light. A split detector is used to generate a background-free signal that renders unprecedented sensitivity for small particles. In its current configuration the sensor is capable of detecting low-index particles in water down to 10 nm in radius or single gold particles as small as 5 nm. We demonstrate the detection of such small particles in a microfluidic system with a time resolution of 1 ms and we discuss the theoretical limits of this novel detection scheme.

*Phys. Rev. Lett. 96, 013901 (2006)*

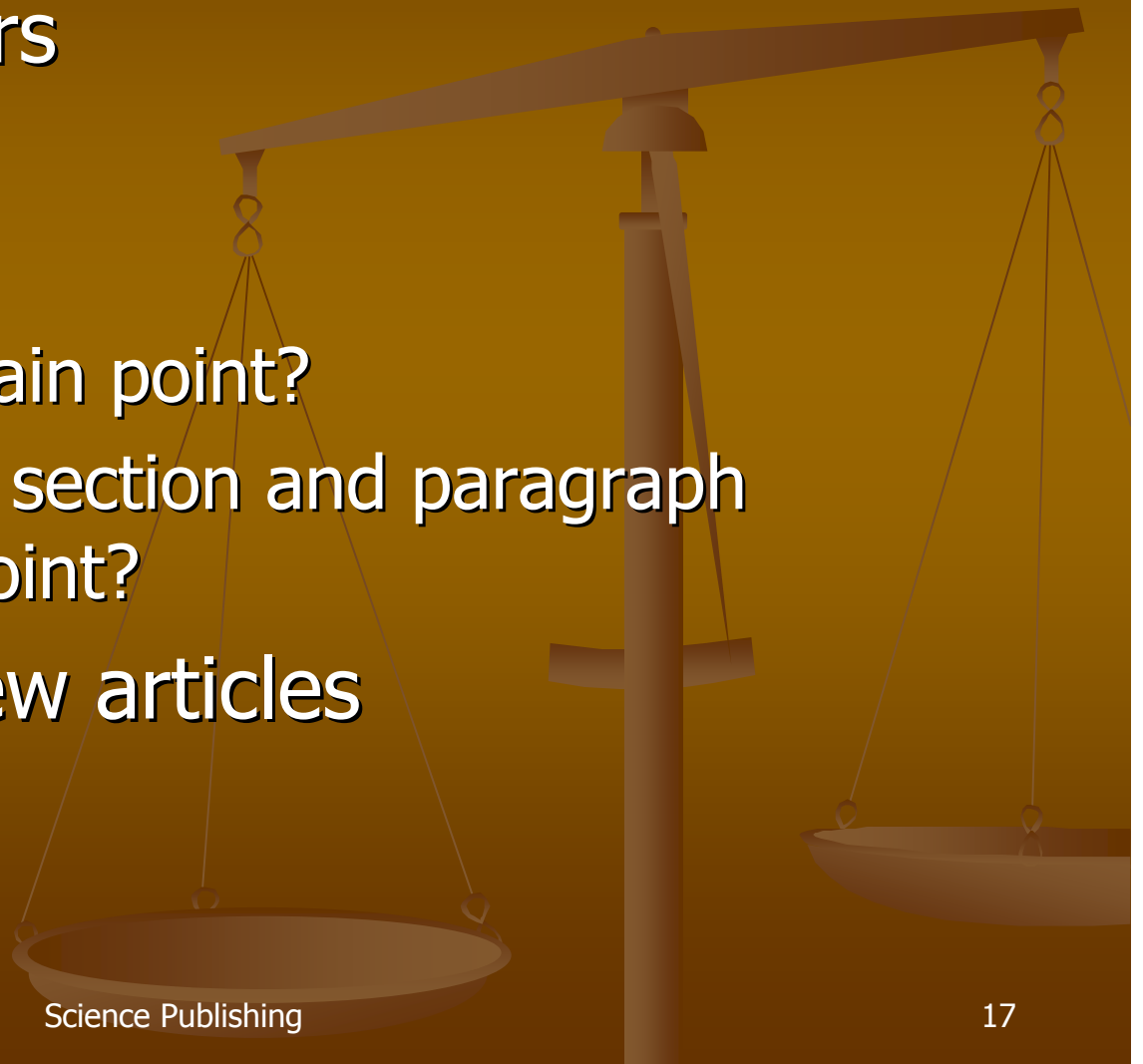
# Keywords

- Prevalence of electronic searching and databases
- Huge increase in scientific literature researchers need to keep abreast of
- Specialized results in infrequently read journals
- Electronic publishing



# Highlighting Key Points

- Beginning writers
  - travel log
- Better Writers
  - What is your main point?
  - How does each section and paragraph reinforce this point?
- Exception: review articles



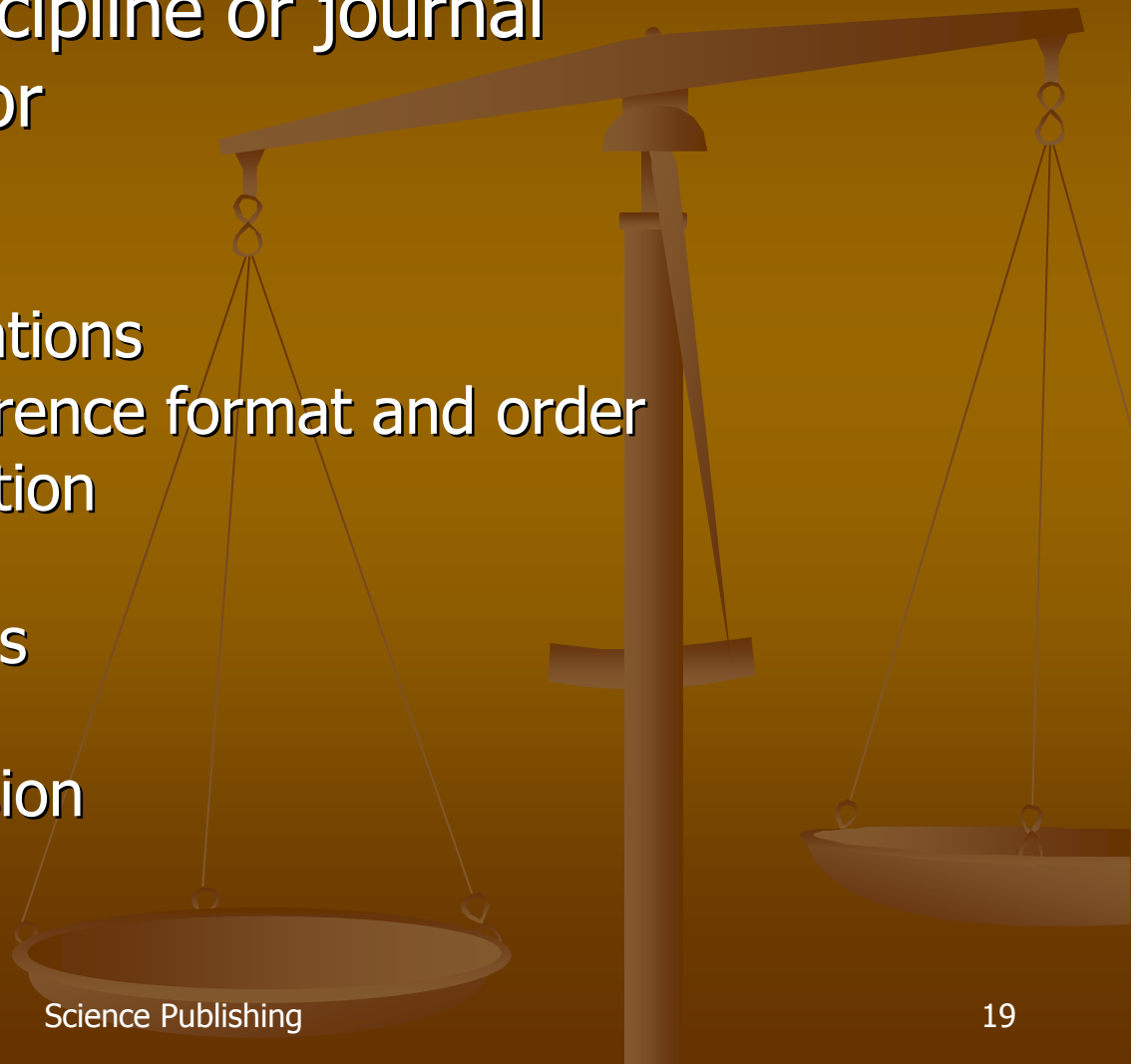
# Avoid Distractions



- Examples
  - Introductory comments about your interest in the work
  - Literary flourishes
- Development
  - Reading what others write
  - Ask yourself which articles are most helpful to you
- Not all readers carefully hang on every word.
- Many of your readers will not be native English speakers
  - Colorful language
  - Colloquial Language
  - AIP Style Manual Example: ball-park figure
  - Avoid complicated sentence constructions

# Style

- Style guide for discipline or journal
- Things to watch for
  - Column layout
  - Size of figures
  - Preferred abbreviations
  - Footnote and reference format and order
  - Symbols and notation
  - Units
  - Display of formulas
  - Abbreviations
  - Length of submission



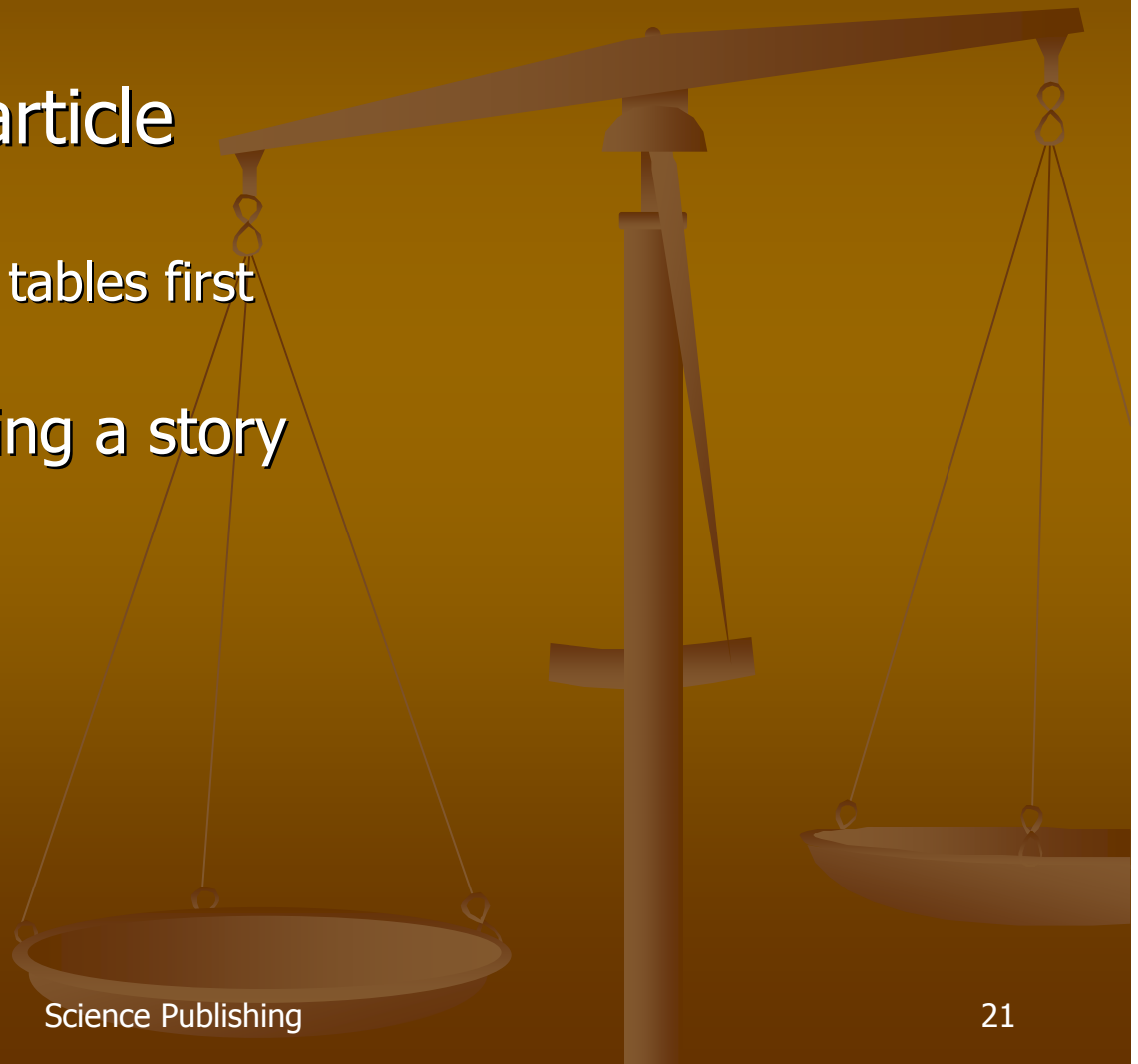
# References



- Not a bibliography
- Read and understand original work you cite
- Triple check accuracy
  - Reader frustration
  - Difficulty of finding errors in proof
  - You may get your reviewers paper wrong
- Find seminal rather than peripheral references
  - Original source
  - Usually historical precedent

# The Writing Process

- Preparation
- Writing the main article
  - Writing inside out
    - Data, figures, and tables first
    - Introduction last
  - Organization: telling a story
- Abstract
- Title last
- Revisions
- Proof reading

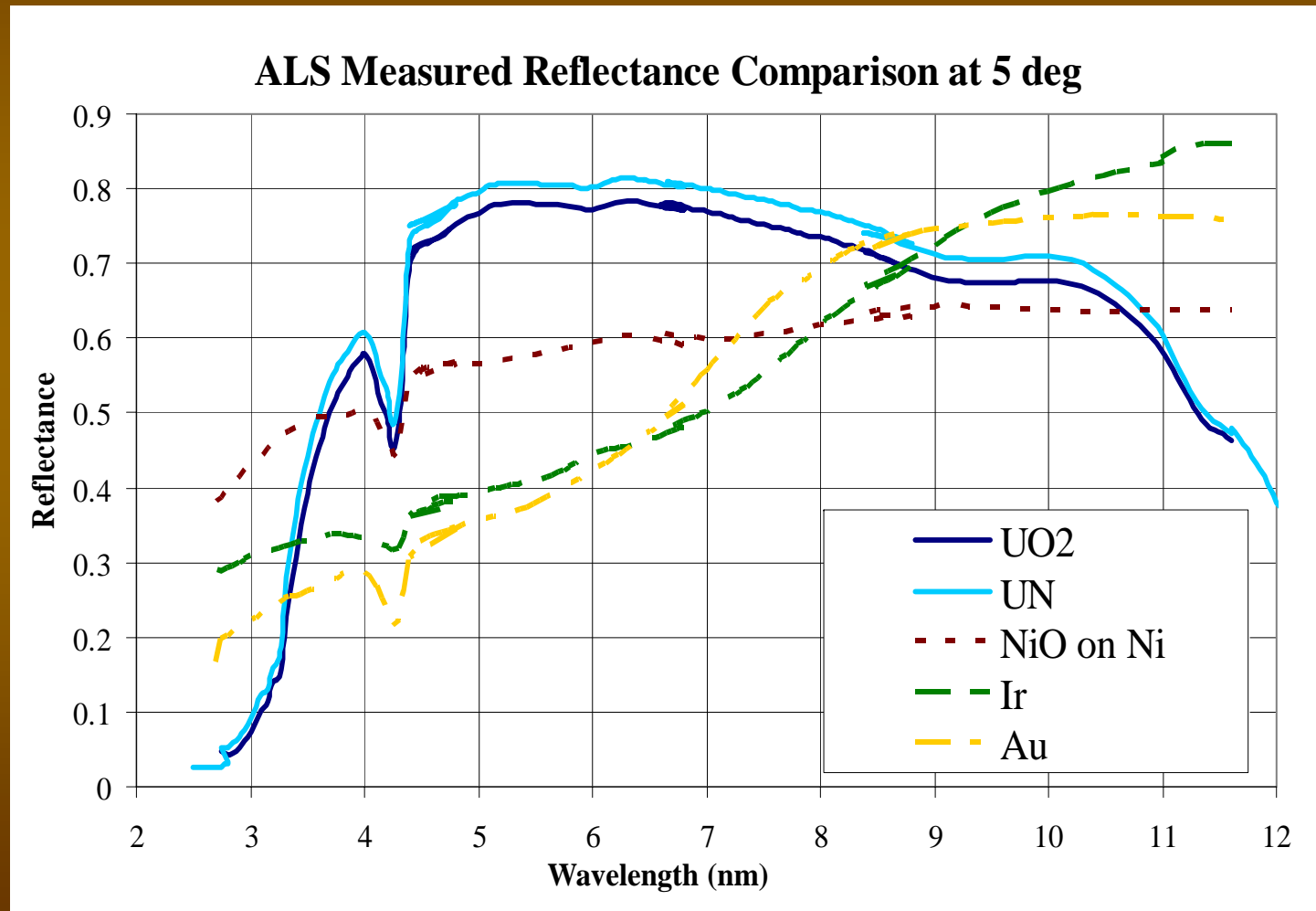


# Preparation

AIP Style Manual (1997): “Despite the natural tendency to feel that no work is being done on a paper when no actual writing is under way, adequate preparation can help insure a logical, readable product and shorten the writing time.”

- Main points
- Oral Presentation
- Outline
- Figures and tables

# Writing Around a Figure



# Revisions

- Share writing with colleagues
  - Include colleague not familiar with your research
  - If its unclear to them, it's unclear (don't argue)
- Let draft sit for a couple of days
- Put yourself in the position of your reader



# Selection of Journal

- How widely is it read?
- Are they interested in articles like this?
- Do the people interested in this subject read this journal?
- Student publishing opportunities in refereed journals
  - Journal of Undergraduate Research
  - Utah Academy of Sciences, Arts, and Letters
  - Refereed conference proceedings
  - Campus journals
  - Joint publications with professors (volunteer to write the article)

# Submission

- Text
  - Electronic or paper?
  - Camera ready?
- Nature of figures
  - Electronic or paper?
  - Font and line size
  - Color
- Captions
  - Inline or separate
- Page charges



# Quality Writing (AIP Manual)

- Audience
- Clarity
- Concise
- Complete



# Audience Awareness

- Experts in field
- Someone coming into the field
- Subject expert with general interest
- Someone looking for ideas to use in another area
- Others
  - Managers
  - Students
  - Public

# Example of Reading Paper

- Interest
  - Physical Optics (Kirchhoff) approximation
  - Reflection (scattering) of light
  - Rough surfaces
- Note: Approach and results are independent of wavelength (light, x-rays, microwaves [radar], infrared, and radio waves are all applicable)

# Finding Article



- **Title:** Analysis of the Iterative Kirchhoff Approximation for Rough Surface Scattering
- Didn't waste many words
- Had critical words I was keying on
- Accurately reflected treatment in article
- Well distinguished from other articles I found
- Author and institution unknown to me

# Abstract

The iterative Kirchhoff approximation has been numerically applied to one-dimensionally rough, perfectly conducting statistical surfaces, and the backscattering predicted from the first and second iterations compared with the "exact" scattering found from the moment method. The  $W$  second-iteration scattering proves accurate at all incidence angles with slightly rough surfaces and up to  $85^\circ$  with large-scale rough surfaces. At HH the second-iteration scattering loses accuracy at  $75^\circ$  with small scale rough surfaces and  $50^\circ$  with large-scale roughness. Scattering models based on the second-iteration IKA actually give better results at HH than would be suggested by the numerical evaluation of the IKA. The numerical results show that these models can be accurately applied to surfaces that include moderate large-scale roughness without first separating the roughness spectrum into large- and small-scale components.

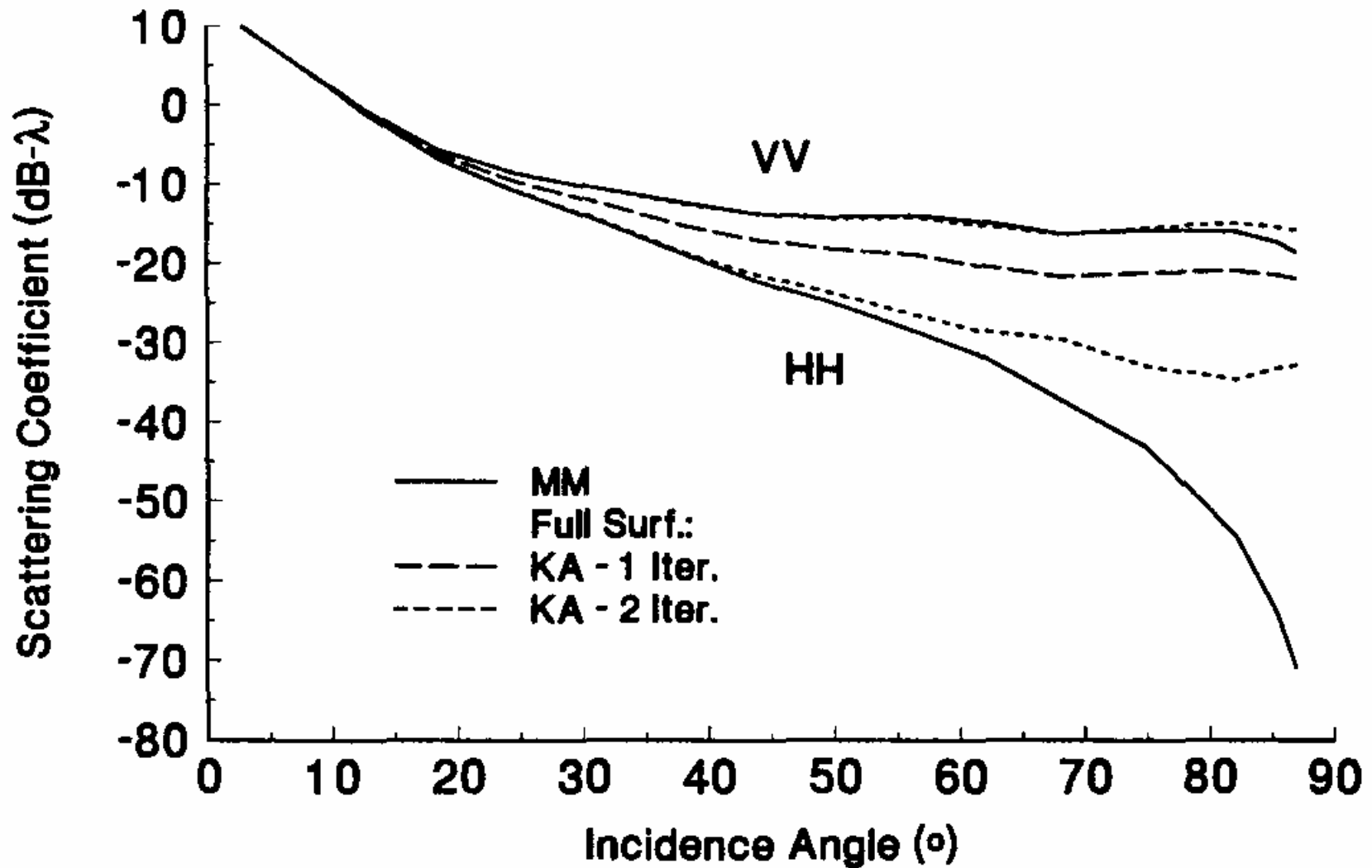
# Section Headings



- Introduction
  - Brief explanation of IKA and its relationship to other computational methods which might be more familiar to the reader
- Calculations
  - Description of surface used for scattering
  - Not one equation (no help in learning method)
- Results
  - Dominated by figures (first thing I looked at)
- Interpretation
  - Summary of applicability of results



# Example Figure



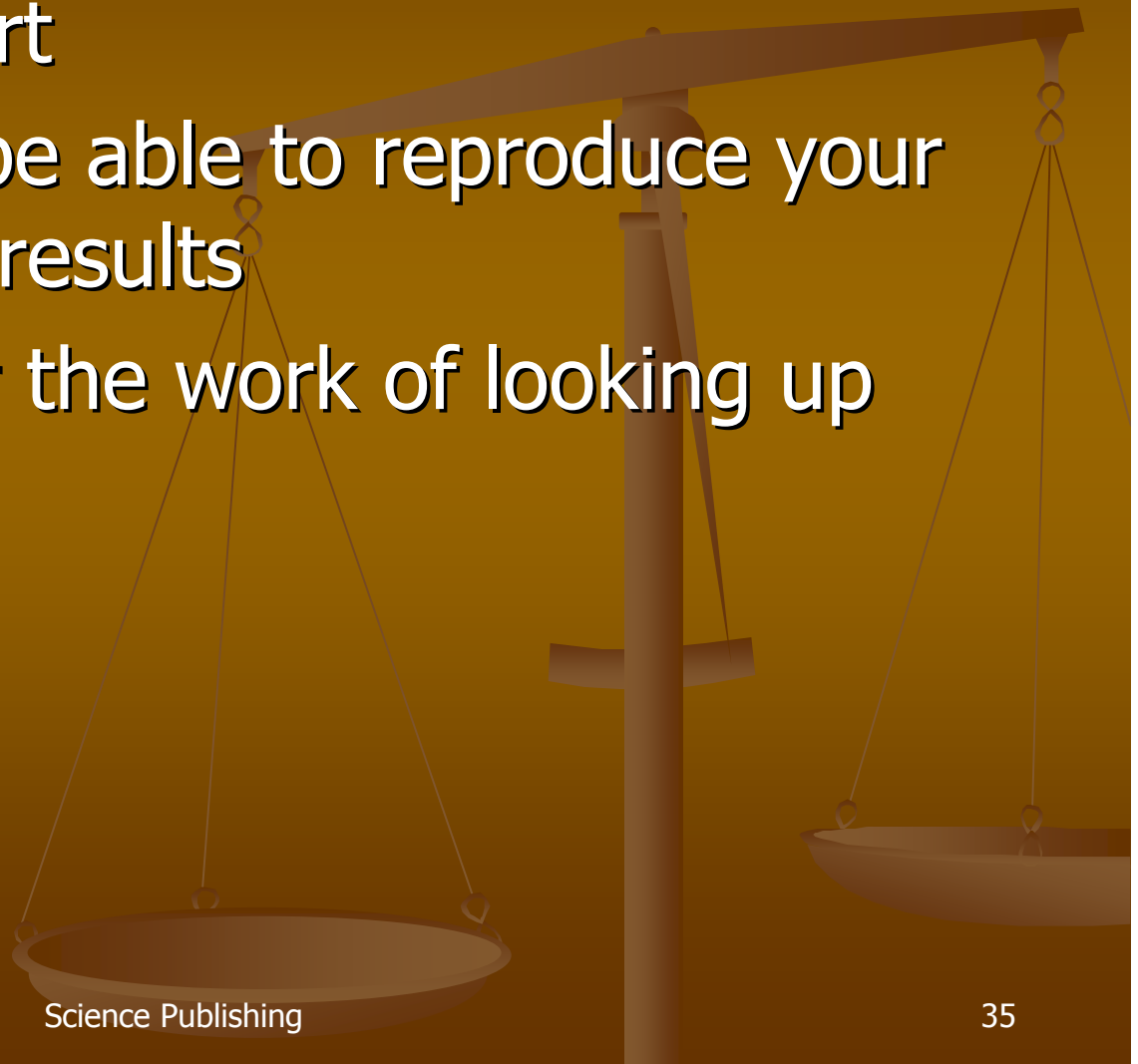
# Clarity



- How else this could it be understood?
- Clear thinking leads to clear writing
  - Do you understand it well yet?
- Let someone else read it
  - Experience writing exam questions
- Avoid jargon and acronyms where possible

# Completeness

- You're the expert
- Reader should be able to reproduce your arguments and results
- Save the reader the work of looking up obscure points



# Use Strong Language



- Active verbs where possible
- Specific goals and accomplishments. What's unique?
- In proposals, talk about what you "did" and "will do," not what you "plan" or "will try to do."
- Make every word count (be concise)
- Every sentence and paragraph should be designed to reinforce your main points

# Strong Language: Good Example

Jason Rowland developed an instrument for measuring reflectivities of multilayer optics in the extreme ultraviolet as a function of angle. His measurements of the reflectivities of U,  $\text{UO}_2$ , and Ru have helped resolve questions about the index of refraction of these materials at  $304 \text{ \AA}$  and  $584 \text{ \AA}$ . He will be presenting the results of his research at the Four Corners Section Meeting of the American Physical Society in October, 1999. His contribution will be included in a publication in the Journal of X-Ray Science and Technology to be prepared later this year. Jason is finishing his degree in physics at Pt. Loma University.

# Strong Language: Bad Example

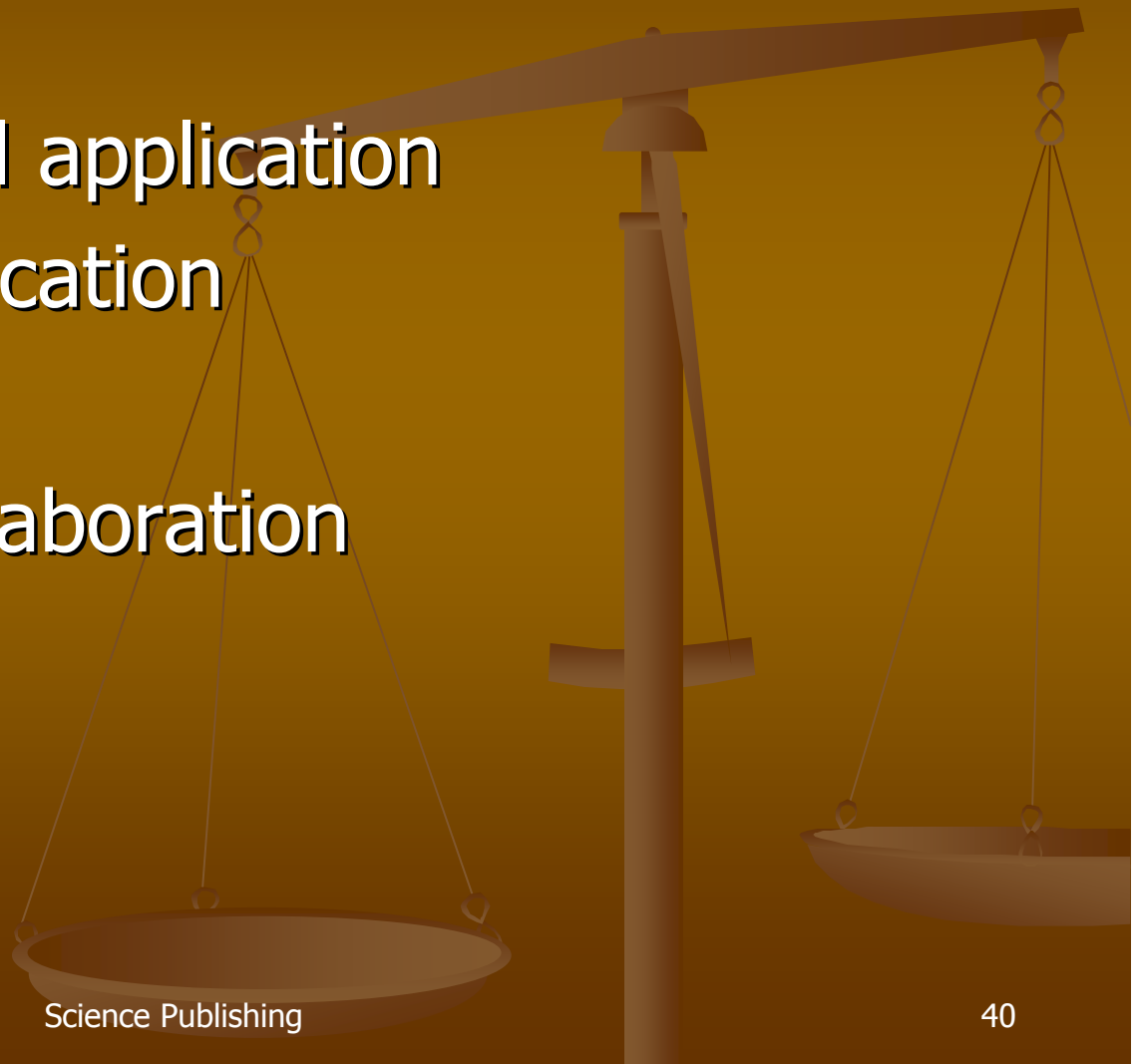
An absolute measurement of the  $^{16}\text{O}(\gamma, p)^{15}\text{N}$  differential cross section for an incident photon energy of 200 MeV was made at the M.I.T. Bates Linear Accelerator. Measurements were made at proton angles of  $20^\circ$ ,  $30^\circ$ ,  $40^\circ$ ,  $50^\circ$ ,  $70^\circ$ ,  $90^\circ$ , and  $110^\circ$ . Cross sections for the process leaving the residual  $^{15}\text{N}$  nucleus in its ground state as well as information about the reactions leading to excited states have been extracted. The ground state differential cross section has been integrated to obtain a total cross section at this energy.

# Get Feedback

- Review by friends before sending
  - Content
  - Typos
  - Strength of language
- Speak to program manager before submission
  - White papers and pre-proposals
  - What would you suggest?
- Ask for feedback from reviewers

# Persuasive Writing

- Grant proposals
- Graduate school application
- Fellowship application
- Job application
- Proposing a collaboration





# Professional Importance



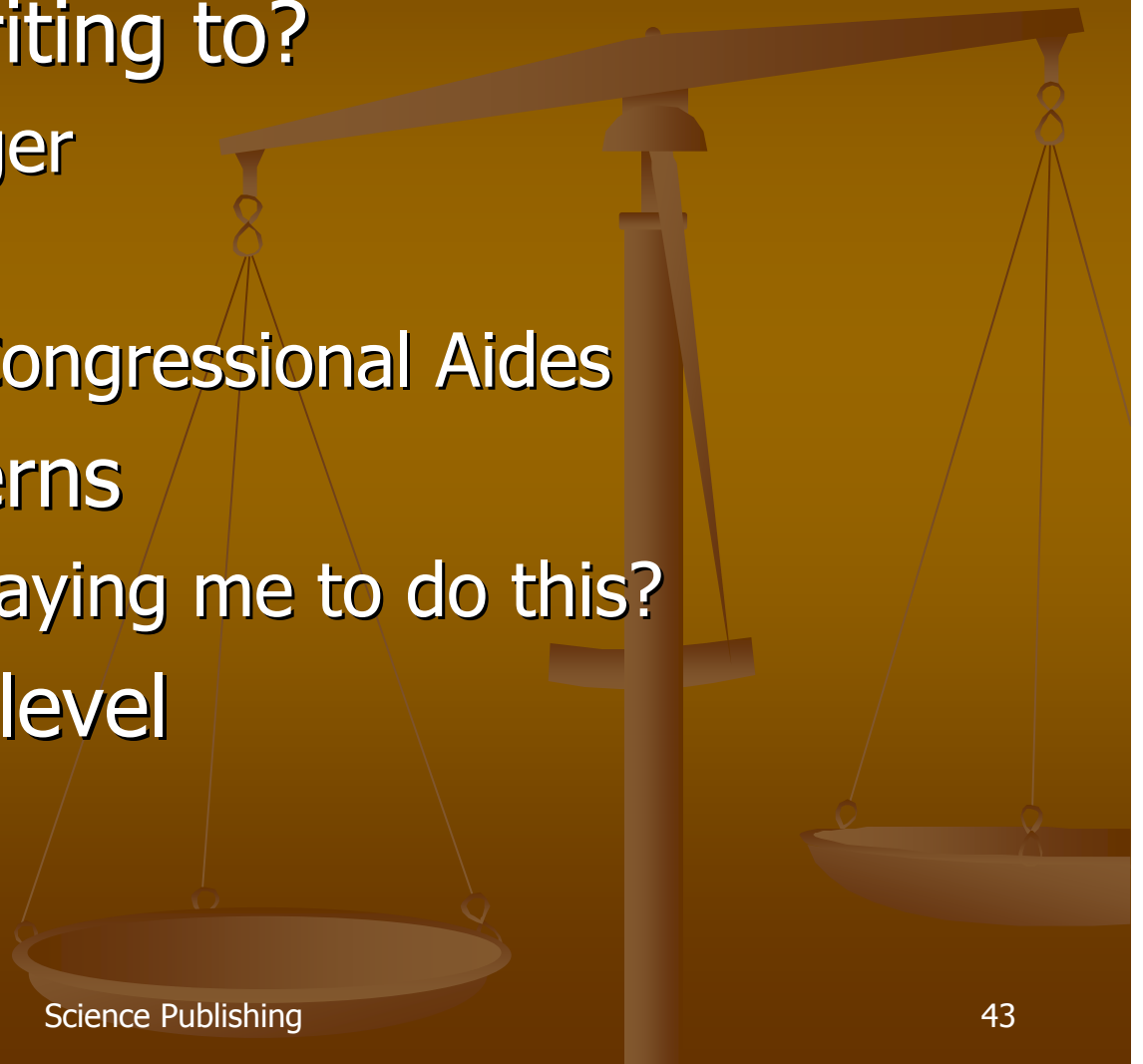
- What professional activities have been important enough to keep me up all night?
  - Hughes
  - BYU
  - M.I.T.
- Bottom line
  - Career depends on ability to get outside funding
  - You will not be hired for some jobs without a demonstrated ability to obtain external funding for your research

# Making Technical Writing Persuasive

- Audience
- Use strong language
- **Persuade, don't sell**
- Get feedback
- **Make the evaluators' job easy**
- **You can't deliver what you don't have**
- **Make it fun to read**

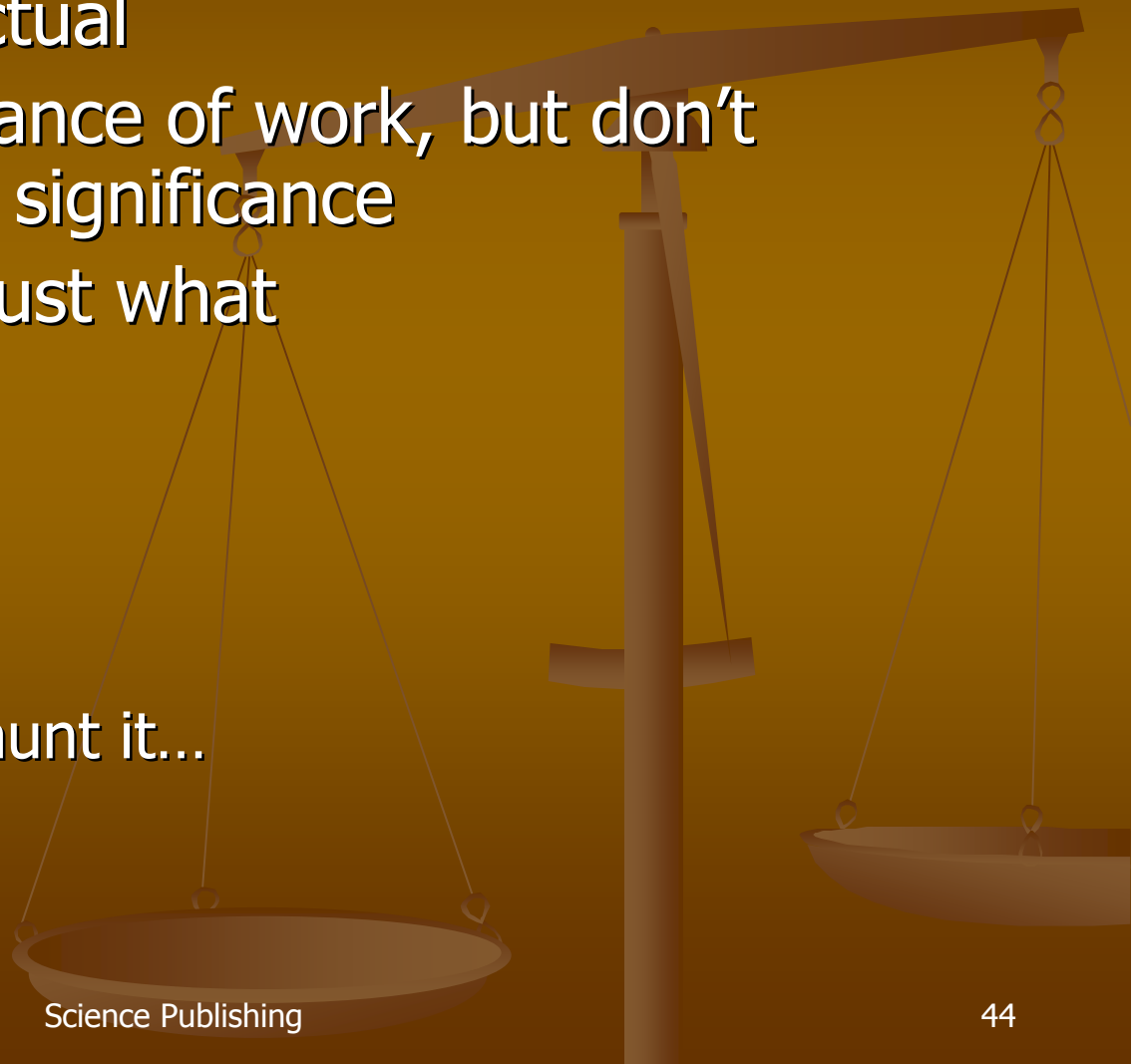
# Audience for Persuasive Writing

- Who are you writing to?
  - Program Manager
  - Administrator
  - Congress and Congressional Aides
- Customer concerns
  - Why are they paying me to do this?
- Writing at their level



# Persuade, don't sell

- Be precise and factual
- Emphasize importance of work, but don't overemphasize its significance
- Explain why, not just what
  - Importance
  - Significance
  - Capabilities
- Don't be shy
  - If you've got it, flaunt it...



# Making it Fun to Read

- Tell a story
- Use a narrative style where appropriate
- Add anecdotes and specific examples
- Use an attractive format
- But...
  - Avoid humor and sarcasm
  - Present facts clearly and succinctly
  - Don't stray from your main point

# Nuts and Bolts of Getting Grants

- Planning Process
- Group/Individual Effort
- Identifying Sponsors
- Size of Awards
- General Content



# Making the Evaluators' Job Easy

- Organize it according to their evaluation forms
- Highlight where they can find answers to evaluation criteria
- Provide them with concise statements they can quote to justify their conclusions
- Provide Table of Contents and Cross References so it is is to find what they are looking for
- Be sure to include an excellent executive summary—that is all some people will read

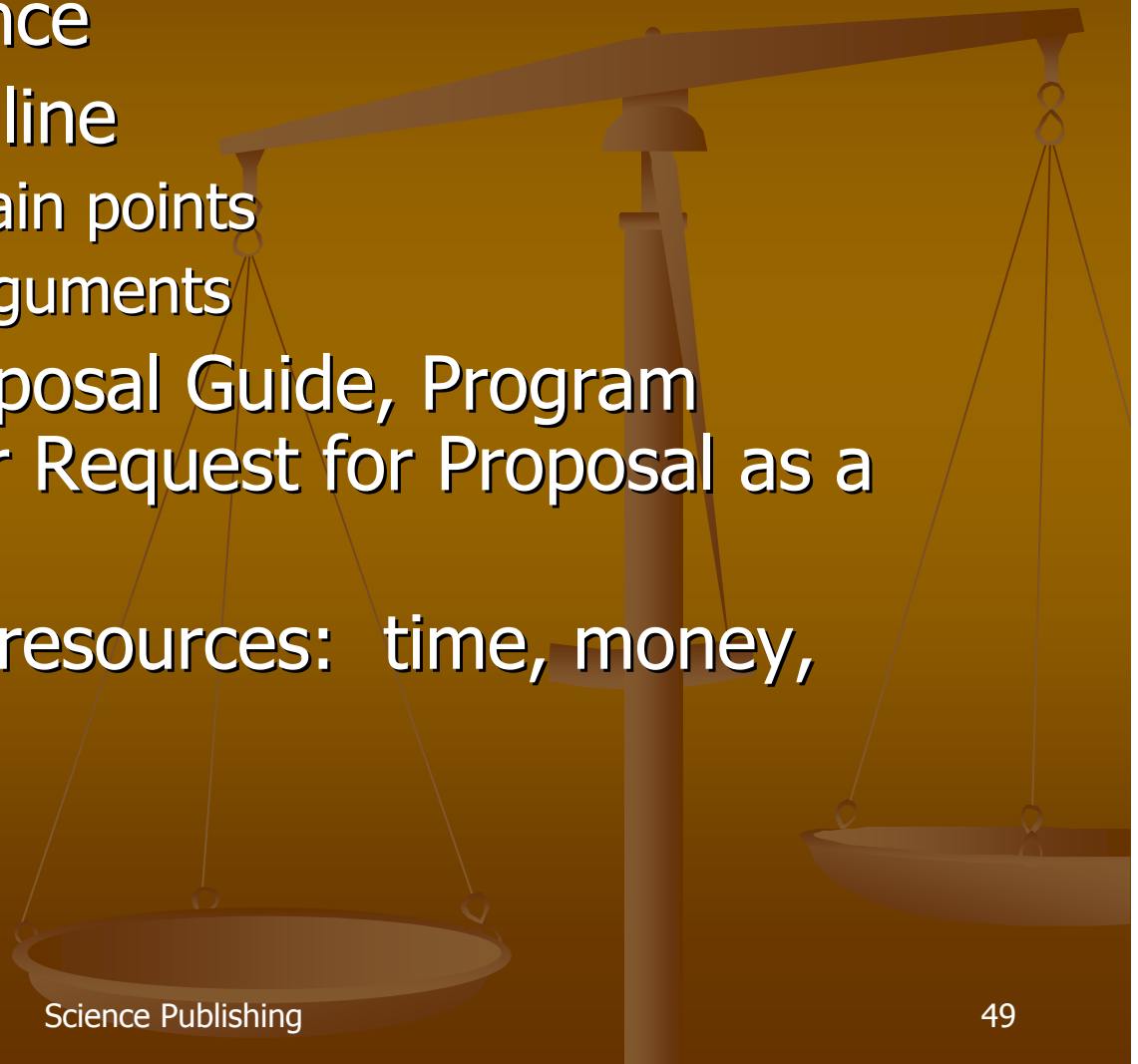
# You Can't Deliver What You Don't Have

- No amount of wonderful writing will make up for lack of content
- Don't promise what you can't deliver
  - The community is small
  - The community has a long memory
- Be sure of institutional commitments for matching resources
- Start small and build on success



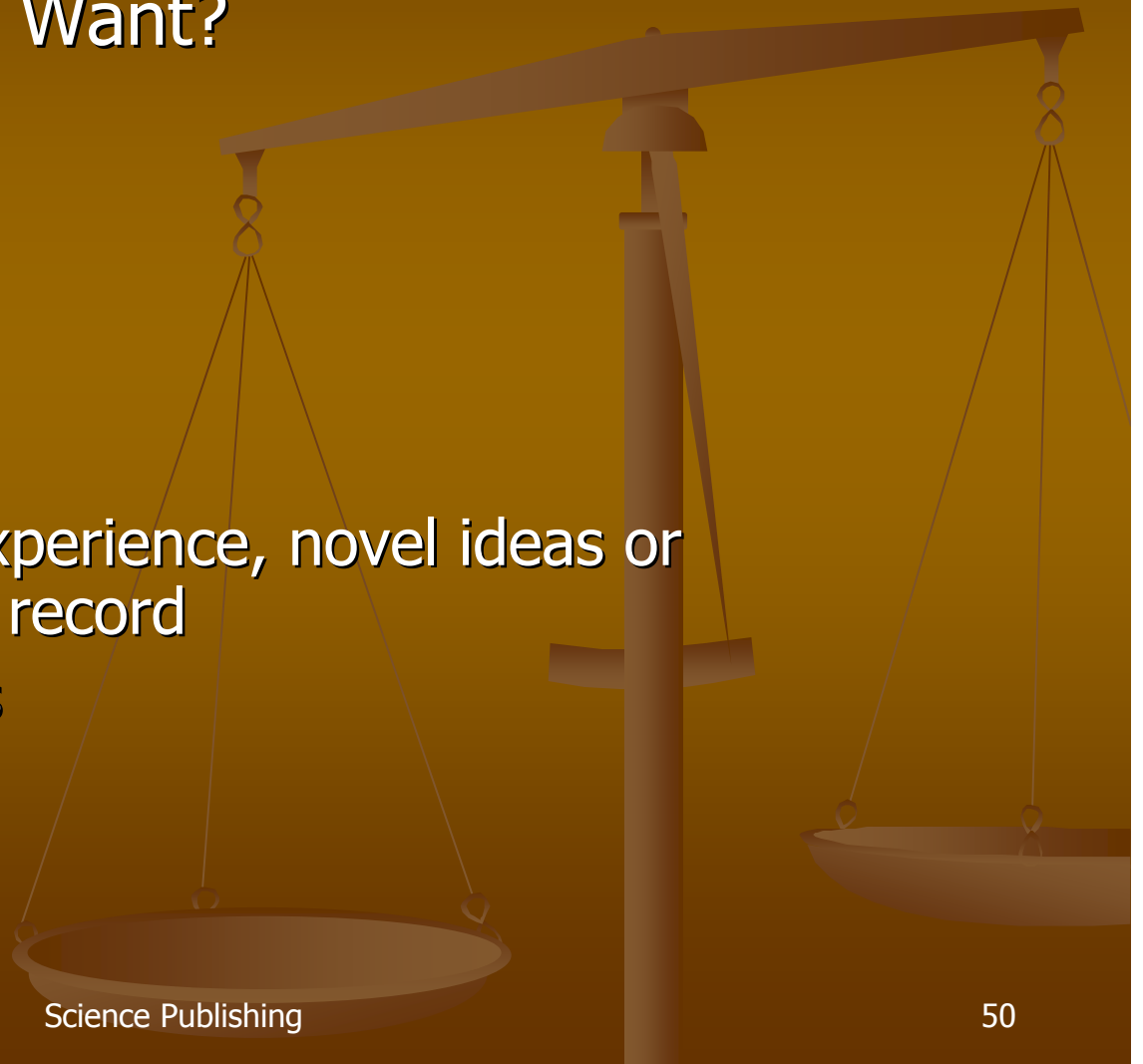
# Planning Process

- Start well in advance
- Decide on a story line
  - Visually outline main points
  - Plug in support arguments
- Use the Grant Proposal Guide, Program Announcement, or Request for Proposal as a Bible
- Allocate plenty of resources: time, money, people



# Is It Right for Me?

- What Exactly Do I Want?
  - Money
  - Recognition
  - Other Resources
- Why Me?
  - Location
  - Expertise: past experience, novel ideas or approaches, track record
  - Matching interests
  - Resources



# Group/Individual Effort



- Industry—I've never seen an individual effort
  - Technical people
  - Support staff: contracts, accountants, attorneys, technical writers, artists, ...
- Academy
  - Small grants sometimes from individuals
  - Usually involves at least a Sponsored Research Office
  - At least let a trusted colleague review your work

# Identifying Sponsors

- Government resources available on the web
- Talk to sponsors
  - Who else might be interested?
- Find out who is sponsoring similar work from colleagues
  - Talk to them
  - Look for acknowledged support in papers
- Go to conferences
- Network!

# Size of Awards (How Much Should I Ask For?)

- Look at past awards
- Talk to program manager
- Find how much has been allocated and how many grants they expect
- Talk to past recipients
- Don't ask for too little or too much
  - ILI Review
  - This program is too extensive for us

# Highlights

- Writing is crucial to success in physics
- Persuasive writing is important for technical success
- Key elements of success
  - Know your audience/requirements
  - Use strong language
  - Practice and get feedback