Useful Tips for Scientific Communication

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(1) Scientific Style

Scientific communication has a special style, and is distinct from all other forms of communication

- not the same as science for the general reader
- the tone is formal and impersonal
- information content is maximized

Literary Style:

> Every day it was the same. Brown, crunchy and tasteless. If I were a free rat, I could find my own food.
>
> In the next cage, everything seemed to be the same. But there was something different. They liked their food more, and their fur looked better than ours.

Conversational Style

> We let some of the rats have just the regular rat food, but we put lipoic acid in for the others.

Scientific Communication:

> Control rats were fed a diet of Rat Chow (Ralston Purina, Inc.) ad libitum. Experimental rats were fed Rat Chow supplemented with 0.5 mg/g lipoic acid.

Hallmarks of scientific communication

- difficult information must be made understandable
- specialized vocabulary
- audience has specialized background (how sophisticted?)
- precision and clarity are the paramount concerns
- standard formats are used for almost everything

Standard formats:

Written:	Progress report/thesis proposal
	Scientific paper
	Abstract
	Thesis
	Review article (2 pages to 100 pages)
	Book chapter
	Book
	Grant application (scholarship, fellowship)
Oral:	Scientific seminar (10 minutes to 60 minutes)
	Thesis defense, oral examination
	Classroom teaching
Hybrid:	Poster

General rules for high quality communication

- begin preparation well in advance
- master the background material
- basic English should be perfect
- be your own harshest critic
- written: draft, revise, revise, get reviewed, (get rejected), revise, resubmit
- oral: draft, revise, practice, revise, practice

You must go over every detail many times to get the end product just right.

(2) Scientific Abbreviations

Purpose and Use of Abbreviations

The only reason to use abbreviations is to make the text easier to read.

Too often, abbreviations make the text more difficult to read!

Abbreviations do not shorten the text appreciably.

Avoid abbreviations unless they are necessary.

Using abbreviations correctly is the single most important thing you can do to improve your writing.

Abbreviation of units of quantity

1) Système Internationale (SI).

2) Correct form is one space, no period.

3) Be sure to use correct Greek letters (or other symbols) and capitals.

5.8 g	6.2 M
5.8 mg	6.2 mM
5.8 µg	6.2 µM
5.8 ng	6.2 fM
6 L	20 V
6 mL	20 mV
6 µL	1.2 V/m
6 pL	10 A
10 sec	10 mA

Rules for non-chemical abbreviations

1) Avoid abbreviations unless they are really necessary. Abbreviations don't shorten a manuscript appreciably. Abbreviations can make a manuscript either more or less readable.

2) Never abbreviate already short words.

antibody patient nucleus control

3) Do not abbreviate standard English phrases.

fish water heart rate hair follicle pituitary gland

4) Do not abbreviate non-chemical words or phrases which are used fewer than five or six times in a manuscript.

5) At first use, spell out complete term, followed by the abbreviation in parentheses.

Samples were analyzed by enzyme-linked immunosorbent assay (ELISA).

Rules for chemical abbreviations

1) Some chemical names should never be abbreviated.

methane sucrose silica gel cholesterol

2) For pharmaceutical compounds use the generic chemical name. Refer to any trade name in the materials and methods section.

We administered buprenorphine hydrochloride (Buprenex; Reckitt & Colman, Ltd.) for postoperative analgesia.

3) For salts and ions, chemical symbols can be used.

$MgCl_2$ KCl Fe^{+3} Na^{+}

4) At first use of longer chemical names spell out the complete term, followed by an abbreviation in parentheses.

We then added 4 ml of 1 mM 1-acetyl-2-phenyl-hydrazine (APH).

5) Always use abbreviations (after spelling it out once) where the reader is more likely to recognize the abbreviation than the actual name.

cAMP HEPES DMEM PBS FGF2

6) Very, very few abbreviations are always acceptable, without explanation.

RNA DNA

7) Use a descriptive name for mixtures.

bad	good
Buffer A	dissociation buffer

Proteins

1) Some protein names should never be abbreviated.

insulin clathrin collagen β-amyloid

2) Some proteins have long names that are commonly abbreviated.

neural cell adhesion molecule (N-CAM)
jun N-terminal kinase (JNK)
horseradish peroxidase (HRP)
pituitary adenyl cyclase activating peptide (PACAP)

3) Some proteins have never had names comprised of English words (even if they were derived from real words).

src c-Jun trkA

It is best to use a descriptive reference the first time such a protein is mentioned.

The transcription factor c-Jun is thought to mediate this response.

Genes

The names of genes should be italicized, to distinguish them from proteins.

src *c-jun* *bca1* *sevenless*

Sometimes the name of the gene and the name of the gene product are not the same.

(3) Scientific Terminology

Spelling

1) Always, always use spell check.

2) British or American? Most, but not all, scientific journals use American English.

color	colour
labor	labour
neuron	neurone
signaling	signalling

Choose one, then be consistent.

4) Use the correct non-standard typography to spell the names of your fellow scientists. It is a form of respect.

Müller Virág Galfrè Hökfelt Lømo

5) Always, always use spell check.

Plural form of nouns – make sure you use these words correctly!

singular	plural	singular	plural
datum	data	ganglion	ganglia
medium	media	perikaryon	perikaria
		taxon	taxa
focus	foci		
locus	loci	soma	somata
alveolus	alveoli	hypothesis	hypotheses
nucleus	nuclei	stria	striae
cortex	cortices		
index	indices		
matrix	matrices		

Definite and indefinite articles (a, the)

1) Omit articles when referring to a general class of something.

Rats are furry, with bare tails.
Rats are included in the order Rodentia.

2) Use articles when referring to specific examples.

> The rats in this study were furry, with bare tails.
> A dead rat was included in the box of disgusting objects.

Preferred usage

use these words	instead of these words
quantify	quantitate (no such word)
corresponding	cognate (means 'derived from the same root')
increase, improve	enhance
variable, factor	parameter
is	represents

Arabic numbers

1) A number at the beginning of a sentence must always be spelled out (this rule has precedence over all of the following rules).

> Forty five rats were used in these experiments.

2) Numbers which are measurements should be Arabic numbers.

> The man's weight was 87 kg. His height was 2 m.

3) Numbers which are counts should be spelled out if ten or less, Arabic numbers if greater than ten.

> We used three groups of 15 rats.

Antibodies and probes

1) There are several abbreviated ways to denote an antibody. Chose one and be consistent.

> anti-NGF α-NGF NGF-IR

2) Be aware of the precise meanings of each of the following terms:

immunocytochemistry immunohistochemistry histochemistry immunofluorescence histofluorescence

3) It must always be clear whether you are referring to the antibody or the antigen.

No: We stained the tissue for β-galactosidase.
Yes: We stained the tissue with an antibody against β-galactosidase.
Yes: We stained the tissue using β-galactosidase histochemistry.

5) Use precision in describing the use of nucleic acid probes.

No: We used a probe for ubiquitin…
Yes: We used a synthetic oligonucleotide probe complementary to ubiquitin mRNA…
Yes: We used a full length cDNA probe reverse transcribed from ubiquitin mRNA…

(4) Sentences

Subject and verb agreement

No: The media contains no serum.
Yes: The medium contains no serum.
Yes: The media contain no serum.

No: This data is consistent with the null hypothesis.
Yes: These data are consistent with the null hypothesis.

No: A few animals is sufficient.
Yes: A few animals are sufficient.

Choose words for clarity and precision.

No: Cell death was different in cultures with the drug.
Yes: Cell death was decreased by 23% in cultures containing 1 mM ascorbate.

No: Mice were injected with 6 mg/kg chloral hydrate.
Yes: Six mg/kg of chloral hydrate was injected into the mice.

Simple is clear

Science is complicated enough. Don't make it unnecessarily so.

No: Myocardial contractile frequency is augmented….
Yes: Heart rate is increased…

State things directly

No: An increase in heart rate occurred.
Yes: Heart rate increased.

No: When frogs are tickled, they tend to jump.
Yes: Frogs tend to jump when tickled.

No: Removal of intact nuclei was achieved by centrifugation of the supernatant.
Yes: The supernatant was centrifuged to remove intact nuclei.

No: Prolongation of life for diabetic patients has been made possible by dialysis.
Yes: Dialysis prolongs the life of diabetic patients.

Change nouns into verbs

No: DNA binding proteins may be involved in transcription initiation.
Yes: DNA binding proteins may be involved in initiating transcription.

No: Proteins precipitated with temperature increase.
Yes: Proteins precipitated when temperature was increased.

No: We tested the possibility that stress causes alteration of glucose metabolism.
Yes: We tested the possibility that stress alters glucose metabolism.

No: Dark rearing results in prolongation of the critical period for plasticity of ocular dominance columns.
Yes: Dark rearing prolongs the critical period for plasticity of ocular dominance columns.

Achieve clarity through consistency of terminology

No: We established primary hepatocyte cultures in plastic flasks. After three days, the liver cell growth medium was replaced.
Yes: We established primary hepatocyte cultures in plastic flasks. After three days, hepatocyte growth medium was replaced.

No: Enzymatic degradation of RNA is possible under these circumstances. To prevent digestion of RNA, we included an RNAse inhibitor.
Yes: Enzymatic degradation of RNA is possible under these circumstances. To prevent degradation of RNA, we included an RNAse inhibitor.

No: Immunoglobulins bind specifically to protein A immobilized on the column. Immunoglobulin association with protein A can then be disrupted in low pH conditions.
Yes: Immunoglobulins bind specifically to protein A immobilized on the column. Immunoglobulin binding to protein A can then be disrupted in low pH conditions.

Don't compare apples to oranges

No: These results are similar to previous studies.
Yes: These results are similar to the results of previous studies.
Yes: These results are similar to those of previous studies.

No: We compared RNA stability in control myocytes to myocytes treated with phorbol ester.
Yes: We compared RNA stability in control myocytes to RNA stability in myocytes treated with phorbol ester.
Yes: We compared RNA stability in control myocytes to that in myocytes treated with phorbol ester.

Sentence structure

Put the subject first, put the verb second, and then complete the sentence.
Avoid the passive voice, where possible.
Make the topic the subject.
Put the action in the verb.

No: There is an alteration in lipid content of white matter as a result of viral infection.
Yes: Viral infection alters lipid content in white matter.

(5) Paragraphs

Composition of clear paragraphs

A paragraph usually corresponds to a single topic.

The easiest way to create a clear paragraph:

The first sentence says what the topic is.
The first sentence provides an overview of the paragraph.
The first sentence creates an expectation that the remainder of the paragraph fulfills.
The remaining sentences provide detail.
The remaining sentences fulfill the expectations created in the first sentence.

Example:

Three theories have been advanced to explain the rise in concentration of carbon dioxide in the atmosphere. The first theory is that……..……..
……..…… This theory is weakened by the observation that.....
……..……. The second theory is that…….....…… Such a theory implies that……...…….…. The third theory, which is supported by our observations, is that…..…….....……..

Example:

We used an in vitro bioassay to assure ourselves that the growth factor preparation was active. Hepatocytes were cultured in plastic flasks, according to the method we have previously described. Growth factor preparation was added…….....……..……. .....…... Mitotic activity was then measured by…….....….....
..... Growth factor preparations which stimulated mitotic activity by less than 85% of maximal were discarded.

Variations of the use of topic sentences

It may take two sentences to adequately introduce the topic.
If there are two topics, two sentences should be used.
The topic can be revisited in the last sentence, to provide a conclusion, a take-home message, or just additional emphasis.

Example:

The primary prey of polar bears is the ring-necked seal. Hunting is carried out from a platform of sea ice. Our data indicate that sea ice cover is decreasing……..……....…… Seals face a decreased requirement to access breathing holes……..… For these reasons, loss of sea ice is expected to reduce the ability of bears to hunt seals.

Organization of supporting sentences

There should be one recognizable organizing theme to the order of the remaining sentences in a paragraph. There are many possible organizing themes.

A list.
Chronological order.
Largest to smallest, or smallest to largest.
Most important to least important (or reverse).
Arguments in favor.
Arguments against.
Arguments in favor, then arguments against (or reverse).
Statement of problem, then statement of solution.

The supporting sentences should satisfy the expectations raised in the topic sentence. The paragraph should feel as if it has reached a natural end.

Reread and revise your paragraphs

Examine longer paragraphs to determine if they contain more than one topic, and should be subdivided.

Examine shorter paragraphs to determine if expectations are left unfulfilled.

Examine each sentence to determine whether it is relevant to the topic, whether it fits into the organizational scheme of the paragraph, and whether it contributes to the reader's understanding.

(6) The Hypothesis

Scientific Method

> Make observations.
> Create an hypothesis.
> Design experiment that will test the hypothesis.
> Collect new experimental data.
> Evaluate the hypothesis in light of new data.
> Accept, reject, or modify the hypothesis.

Much science is not actually carried out this way.
Some scientists never get past step one.
Some scientists never even do step one.

"I wonder what happens if..." is not a very focused inquiry.

If you are a good scientist, you probably have an hypothesis in mind when you designed your experiments.

Brilliant scientists create <u>novel hypotheses</u>, and then devise <u>definitive experiments</u>.

Some hypotheses are trivial.

> We hypothesize that the teacup will break if dropped on the floor.

Some hypotheses are monumental.

Gravity is a manifestation of the curvature of space-time caused by a massive object.

Sometimes the interesting hypothesis does not occur to you until you have completed the experiments. Before beginning to write, re-evaluate your results to determine what the most interesting question you have answered is.

Good scientific writing includes:

- the statement of an hypothesis
- the data that were obtained as you tested it
- an evaluation of the whether those data support or refute your hypothesis

Write it that way, even if that is not the way the study was done.

Determine whether you are answering these questions:

What is your hypothesis?
On what basis did you formulate it?
Why is your hypothesis important or interesting?
How are your experiments designed to test that hypothesis?
Do the methods you chose actually constitute valid tests?
What data did you obtain?
What do your data mean?
Should the hypothesis be accepted, discarded or modified?

Types of thought

fact	small idea, accepted as true forever
concept	any idea, true or not
theory	a conceptual structure, provisionally accepted
hypothesis	a testable idea
conjecture	educated guess
notion	fanciful thought (do not use in scientific writing)

Degrees of causality

A proves B	almost never justified
A implies B	strong
A supports B	middling - often the best you can do
A suggests B	weaker
A is consistent with B	virtually irrelevant

Degrees of certitude

A is proven	almost never justified
A is likely	is this your opinion, or statistical evidence?
A seems likely	your opinion (opinions don't count for much)
A is supported	use whenever you can

(7) Scientific Format

Scientific writing almost always adheres to a specific format

- Annual Progress Report
- Thesis Proposal
- Meeting Abstract
- Poster
- Grant Application (Scholarship, Fellowship)
- Journal Article
- Review Article
- Book Chapter
- M.Sc. or Ph.D. Thesis

Keep in mind who your audience is.
Keep in mind the strengths and weaknesses of the format.
Strive for precision and clarity.
Should be thorough, must be concise.
Everything must be clearly stated.
Everything must be clearly and logically organized.

Core organizational features of a journal article
This is the standard scientific format, most other things are variants of this form.

Abstract

Must say it all, must say it succinctly
One super-packed paragraph
- what is the question?
- what is the experiment?
- what are the results?
- what is the answer to the question?

Most readers will not get past the abstract
Must be written extremely carefully
Write your abstract last, after everything else is completed

Introduction

Provides background to support the statement of a question or hypothesis
    describe what is known
    point out what remains unknown
    state the question or hypothesis
Your paper makes a stronger point if it asks the right question
    what question makes your results most interesting?
    change the question!
Start with a draft, but rewrite final version second to last

Materials and Methods

Write this section first
Easiest section to write
    bland, mechanical description of what you did (or will do)
Organize by subheading
Level of detail is variable
Theoretically allows any reader to repeat your experiments
    (someone might actually attempt to repeat your experiments)
Most readers want to judge whether your techniques are sound
Every "result" must have a corresponding method

Results

Write this section second
Organize by subheading
Include and describe all data, tables, figures
Use what would have been the logical order, even if it didn't happen that way.
Can be presented as a story:

    "Based on this finding, we then decided to study whether…"

Organization and preparation of clear, professional figures is crucial!

Discussion

Hardest part to write
You are no longer a 'reporter' or a 'technician'; now you are a 'scholar'
Do not begin with a new Introduction
Do not begin by restating the Results
Begin by answering the question you asked in the Introduction

    "The results of this study show that cancer cell metastasis can be
    influenced by a number of dietary factors."

Thus, you begin the discussion by stating the main point of the paper.

Write a series of topic sentences that are logically organized, then reorganize them as you write
Each topic sentence will eventually become a paragraph
Organize by subheading

What to include in discussion
- Interpret your data
- Optional: comment on reliability of methods
- Explain how your findings answer original question
- Fit your findings into the literature
  - confirm, refute, extend previous studies
  - provide new information or insight
  - tell the reader why your work is important!

- Omit anything not directly relevant
- Clearly state your conclusions

May have Conclusion or Summary, section (usually does not)
In any case, end by restating major finding(s), and/or answer to question

What you may discover as you write your Discussion:
- deficiencies in your literature review
- deficiencies in your experiments
- you need to restate the question

This is when you can really improve your paper!

References

Allows you to be more concise
Allows reader to learn more
Courtesy to those whose work you are building on
Demonstrates that you are aware of what others are doing

Construct the reference list as you write the other sections
- specialized software, i.e. "Endnote"

After all revisions, check that all references are referred to, then number them, if necessary
Different journals have different reference formats

<u>Variations in the format of journal articles</u>

Almost all journals follow the traditional format closely
Some high-impact journals have an altered format (Science, Nature, Cell)
- Methods shunted to less prominent position
  - last section in small type
  - figure legends, references

Many journals have strict word limits

Some journals have special "brief articles" or "rapid communications"
Many journals may offer additional data sections that are on-line only (supplemental data)

Other writing tasks have other organizational schemes

Thesis proposal/progress report

No abstract
Introduction is paramount
- demonstrate that you now the literature
- clearly state an hypothesis

Describe all methods
Results may be preliminary
You must describe experiments that are planned, but not completed
Discussion centers of the significance of answering question (even though it is not yet answered)

Poster for a scientific meeting or display

Text should be extremely minimal, yet all sections should be present
Abstract is written just like a full-length paper (may be published)
An Introduction (one paragraph) states the hypothesis or question
Figures are of paramount importance
The Results section is the figure titles
The Methods section is the figure legends
Present conclusions as a bulleted list

Be prepared to talk someone through your poster in two minutes
Poster must be clearly understandable by itself, in case you are not there

Grant Application (also, Scholarship and Fellowship Application)

Introduction needs to be engaging and interesting, and needs to provide all information necessary to understand the rationale behind the project
Hypothesis and Specific Aims should be made 'screamingly' obvious
Research Plan addresses each Specific Aim, one by one
Each section of the Research Plan corresponding to a Specific Aim should have:
- methods
- expected results (and any preliminary results)
- alternative approaches

No traditional Discussion (no results yet)
A concluding section makes an argument for the anticipated 'significance' of the study

Normal References section
Additional Sections (must also be carefully written):
- biographical information on applicant
- budget
- time line
- lay summary - sometimes difficult, always important

Review Article

An Introduction and Discussion merged
Thorough exploration of previous literature
Not for presentation of new data
Hypotheses and Questions should be identified
- which ones can be answered
- which ones cannot yet be answered

Critical evaluation

"These findings conflict with others that imply..."

"Several observations make a strong case that..."

M.Sc. or Ph.D. Thesis

Traditional organization
No page limit, but don't be repetitive, don't go too far afield
- examining committee will grumble if it is too long
- examining committee will flunk you if it is too short

Abstract - one paragraph, one page
Introduction - wide ranging review, identify several questions
Materials and Methods - be very complete, supplement with appendices if necessary
Results - include complete presentation of all data, including statistical analysis
Discussion - should include subsections discussing each type of result, then go on to a general discussion of how the new body of work fits into the previous literature and advances our knowledge

Thesis preparation and defense

Your supervisor will review sections as you write them
The final written thesis must be completed one month prior to your defense date
You will defend your thesis in an oral examination lasting 2-3 hours
The oral examination begins with your 15 minute overview of your thesis work in an oral presentation
The main examiner will be an outside expert that you have not met before

You will be asked broadly ranging questions to test your knowledge of the literature pertaining to your topic
You will be asked very specific questions about your techniques, your data analysis and your interpretations

All scientific writing

Strive for clarity and precision
Everything must be concise and directly relevant
English grammar, spelling and typography should be perfect
Make it as easy to read as possible
Follow format instructions exactly
    word and page limits, margins and type size
    give exactly the information that is required: no more, no less

(8) Presentation of Data

Data are the points of scientific evidence used in the evaluation of an hypothesis
    your hypothesis raises the question (creates an expectation)
    your data answer the question (fulfill the expectation)
    data are of central importance
    data must be collected, evaluated and presented correctly
    figures and tables are the primary devices for presentation of data

Some readers will only look at the figures, and skip the text.

Figures can also be used to clarify experimental methods.
Figures can also be used to summarize data, or to present an interpretation of data.

What goes in Text, and what goes in Figures?

Virtually all of the data which are presented for the purpose of evaluating your hypothesis (or answering your main question) should be presented in figures, then mentioned in the text.

<u>Exceptions:</u>

Some findings are so simple that they don't merit a figure.

    The mean whisker length of the rats used in our study was 3.12 cm.

Sometimes the data are borderline trivial.

> There was no significant difference in eye blink frequency between saline injected control and uninjected control animals (data not shown).

You should also describe your data in the text of the Results section, with reference to the figures in the order that they appear.

Figures (including tables) are usually embedded in the text, although it is not always possible to have them on the same page as the text description of the data.

All figures should be constructed at the exact size that they will appear in your publication

best way to make sure it looks right in print
read the "instructions to authors" first
all journals require electronic submission
standard graphic formats (jpeg, tiff, etc.)
size: one column width or two column widths

Tables

Use tables for precise presentation of multivariate data.

Independent variables are shown in the first column.
Dependent variables form subsequent columns.
Comparisons are made by reading down a column.

Horizontal lines separate headings from data.
Do not use vertical lines.
Insert footnotes from left to right.

A typical table allows you to present multiple measurements, and multiple features of each measurement:

N
mean value
(can be multiple measured outcomes)
error or variance
difference from control
statistical significance
verbal descriptions

Tables are especially valuable when:

data are not numerical
numerical data are difficult to graph
you want to present data case by case

Graphs

A wide variety of numerical data presentation formats is available.
Choose the graph format that is most appropriate for your data.

The best graphs are simple. It is easier to read several simple graphs side by side than to read one very complicated one

Bar graphs show comparisons between groups.
Line graphs show trends as functions.
Scatter plots can show relationship between two dependent variables.

More sophisticated formats are harder to understand (is their use justified?)
- frequency histograms
- cumulative frequency plots
- 3 dimensional (3 variable) graphs

General rules for all graphs:
Independent variable should be shown on horizontal axis.
Dependent variable should be shown on vertical axis.
Include zero on any numbered axis, if at all possible.
(there is no zero on a logarithmic scale)
Make the axis range the same for all comparable graphs.

Choose appropriate text sizes. Use a sans serif font (i.e. Arial).
in descending order:

panel letter	18 - 24 pt, bold	**A B**
heading	18 - 20 pt	bone density
axis labels	12 pt	cholesterol (mg)
scale numbers	no smaller than 9 pt	100

Use simple shading or color to provide contrast and clarity

Be consistent from graph to graph
- graphing software makes this easy
- template: make your first graph and adjust it the way you like
- make a copy
- substitute in new data for next graph

Line graphs
- Choose appropriate line thicknesses.
  - avoid dotted, dashed lines, when possible
- Choose appropriate symbol size
- Do not crowd too many plots onto one graph

Error bars:
- choose statistical measure of error carefully
- error bars should go both ways
- denote P values with asterisks

Bar graphs

- Bars should be wider than the spaces between them.
- Avoid fancy bar fill patterns:
  - stick to black and white, or cross-hatched, or solid colors
  - never use 3-D bars, or shadowing
- Do not crowd too many bars onto one graph
- Error bars:
  - choose statistical measure of error carefully
  - error bars should go both ways
  - denote P values with asterisks

Drawings

Drawings that illustrate a method are usually clearer than photographs
- apparatus
- anatomy
- surgical approach

How to make a line drawing:
- it is impossible to draw with a mouse
- use straight lines, squares, circles, etc. if possible
- make hand drawn figures with a black Sharpie on hard white paper
  - use different width lines
  - use different colors (if you like)
- make it 2-3 times final size
  - scan it, touch it up, then shrink it to final size
- add all text and straight line art to the electronic image last

Photographs

Beautiful photographs make a very positive impression.
Indistinct photographs make a very negative impression.

Color photographs look better.
- strictly speaking, color is often unnecessary, but use it if you can
- more journals are eliminating extra charges for color

Photographic data should always be quantified whenever possible.

To produce a good photograph, everything must work correctly.
- your laboratory preparation must be high quality
- you must know how to use your microscope properly
- you must know how to use your camera properly
- you must now how to use your image software properly

Photographic quality (resolution) can only decline at each step - your job is to minimize quality loss.

Use high enough contrast to make details distinct.
Use low enough contrast so that background is visible.

Construct original figures at their final publication size.
- journals now usually require this
- makes it easier to properly scale details, font sizes

Include a scale bar in lower right corner (define its length in the figure legend).
Include panel letters in upper left corners
- large, bold
- black on white, or white on black

Arrows, asterisks, etc. can be placed within image electronically.

Figure Legends

The reader should be able to understand a figure without referring to the main text.

There can be considerable variability in the function of figure legends:
- papers and thesis - the basic facts
- shorter papers - may have more methodological detail in figure legend
- posters - figure title must state the important message
- seminar - no figure legends

In general, the figure legend should include:

1) a beginning statement of the method used (perhaps just a phrase)

Figure 4. Electron micrographs of...

Figure 6. Chromatographic elution profile...

Figure 8. Western blots of tissue extracts using anti-vimentin.

3) an explanation of all symbols, arrows, bars, and abbreviations

Solid arrow indicates nucleus. Bar represents 50 μm.

4) method of statistical evaluation and P values

Student's T test. *P<0.05, **P<0.01.

Figure legends should be concise, but complete.

(9) How to Give A Talk

The act of speaking is different from the act of writing
- the human voice can be inflected
  - another layer of communication
- cannot edit at time of delivery
  - only one chance to deliver a final product
- the delivery of words and pictures is simultaneous
- schedule, place and time allotted are fixed

The act of listening is different than the act of reading
- audience conflates messenger and message
- information absorbtion is in real time
  - audience cannot go back to review
- the delivery of words and pictures is simultaneous
- schedule, place and time allotted are fixed

Types of oral presentation

Classroom presentation or journal club (less formal)
Advisory committee meeting (less formal)
Departmental seminar
Thesis defense
Presentation at a scientific meeting or seminar series (most formal)
- 10 min, 20 min, 30 min, 50 min, 60 min….

Job interview
Poster presentation
Public lecture
Teaching

You may give the same (or similar) presentation several times

What you need to know first

Two main features determine how you should prepare your talk:

<u>Time alloted</u>
- one hour seminar
  - Plan to speak for 45 min
    - 5 min lost at the beginning
    - 5 - 10 min for questions
    - there may be pressure to vacate the room
- 10 or 15 minute meeting presentation
  - Must be tightly scripted
  - 2 min for questions

Thesis defense
- 15 to 20 min overview
- Extensive questioning

Audience
- Degree of sophistication
  - Scientists with similar research interests
  - Scientists in same general area
  - Scientists of varied interests
  - Academics including non-scientists
  - Students with limited background
  - Students with good background
  - Patient groups
  - General public

Advance preparation

Design your talk to fit the time available and audience sophistication
Prepare your speech
Prepare your visual aids
- visual aids are subordinate to speech
- do not plan to just talk your way through the pictures

Edit, revise, rehearse, revise…

Getting the audience to show up
- Choose an interesting, informative, welcoming title
- Get your title to the secretary on time!
- Be sure your talk is advertised well in advance
- Sometimes you must advertise your own talk
- Let colleagues know that you want them to come

Preparation of Spoken Words

Preparation - know what you are going to say
- Write it out
  - Outline form is OK for informal presentations
  - Write it word for word for short, formal presentations
- Revise, rehearse and revise
  - Look for difficult phraseology, find a way to say it more simply
  - Are there several words for the same thing?
    - Chose one and stick with it
  - Be sure of pronunciation of difficult words
  - Memorize key phrases
  - Look for difficulty in getting a concept across - rethink the concept
  - Look for and eliminate redundancy
  - Make sure you conform to time limit
  - Coordinate with visual aids (see below) - look for inappropriate or missing images

For short presentations, memorize entire talk
For longer presentations, memorize opening lines, key sentences
Anticipate questions
formulate answers to obvious questions
be sure you can quickly re-display data
have additional data available

The more you practice beforehand, the more confident you will be.

Preparation of Visual Aids

Visual aids are subordinate, your speech is the main thing
do not reproduce your speech on your slides
visual aids are for visual (not verbal) communication
Your visual aids should be closely coordinated with your words

Types of visual aid
Unaided (speech)
Blackboard and chalk
Flipchart and markers
PowerPoint
Multimedia

Keep visual aids clear and simple
minimize text - do not use complete sentences, keep lists short
one graph or photograph per slide
(unless a side-by-side comparison is required)
try not to use tables
cartoons, diagrams, flow charts are good

Text must be readable from the back of the room
bigger is virtually always better
use sans serif and bold fonts
insure high contrast
make good use of color
numbered lines or "bullets" are good
use PowerPoint features to highlight text sequentially

Do NOT use fancy Power Point features
sound effects are amateurish and distracting
zooming words are amateurish and distracting
tricky "dissolves" are amateurish and distracting

Strip away all unnecessary words:

no: **Physical characteristics of elephants:**
1) elephant skin is 2 - 3.5 cm thick
2) elephants can lift 200 kg with their trunks

yes: **Elephants:**
- thick skin
- strong trunks

Better yet, use a picture

How many slides?
consider the length of time necessary for each image
some may be designed to flash by in a second or two
some may require two minutes of explanation
rule of thumb: one slide per minute

Format
1) Introduction
provide necessary background
state the main point of inquiry (hypothesis)
tell them what you are going to say
2) Main Body
say it
3) Conclusion
tell them what you just said

Compose Main Body first
Start with an outline
Select and arrange your data to make a focused story
One to five closely related points
Do not combine disparate studies
Make sure everything relates to a clear point
Present points in logical (not chronological) order

Methods, Results and Interpretation are mixed together
(not the same as a written paper!)

Compose Introduction next: How much background?
10 - 20% of your talk (5 - 10 minutes of an hour seminar)
Introduce all major concepts
What is the problem that your talk addresses?
What hypothesis is being tested?
State the key previous findings which are directly relevant
Show how previous work sets up question(s) to be addressed
End introduction by stating what you are going to say

Compose Conclusions last
Less than 5% of your talk (2 minutes of an hour seminar)
Present a short list
- make sure everything is clearly stated
- make sure it is well supported
Generally, save "future directions" for question period

Oral communication skills

Managing your equipment

- Check out the room ahead of time, before anyone arrives
- You must insure that projection equipment, etc. is present
- You must be prepared to control lighting
  - dim lights enhance projected images
  - dark room puts audience to sleep
  - speaker should not be in complete darkness
- Use a microphone if necessary
  - lapel microphone - is there a cord attached?
  - table or podium microphone - remain in correct range
- Choice of pointer
  - Laser pointers can be annoying
  - 1 meter rod works very well, if you can reach the screen
  - Small pointer (pencil) is better than nothing
  - Power Point features can substitute for pointer

Before you begin

Sit in front row or stand to the side as you are introduced
Bring your notes with you - they are there for reference if you get stuck, but you should refer to them as little as possible

Where to stand?

- Standing behind something signals formality
- Standing in the open engages audience more directly
- Do not block the projection screen for any audience member
- It is good to move around - don't trip over wires or fall off the stage

Body language

- Wave hands, move around to elicit visual interest
  - the visual system is involuntarily attracted to movement
- Make eye contact: don't look at the floor, don't look over their heads
- Look relaxed, look confident

Tone of voice

- Be sure the people in the back can hear you clearly
- Speak slowly, pause for emphasis
- Do not speak in a monotone - animate your voice
- Do not use a conversational tone
- Do not lapse into "uptalk" (?)

Answering questions

- Answers should be brief, and directly to the point
- Combine confidence with humility
- "I don't know" is usually safe and acceptable (exception: thesis defense)
- Look for opportunities to score one more point
- Remain professional and cordial, even with a hostile audience
- If one person persists, suggest continuing the discussion later

Things that audiences hate

They are unable to hear
The visual aids are poor
The speaker runs overtime, or skips things at the end
The speaker has a boring voice
The presentation is poorly organized
There is too much unnecessary detail

(10) Visual Aides to Speaking

Your visual aides are supposed to complement (not duplicate, not replace) the words you speak.

Purpose of visual aides

complement the spoken word
more fully engage the attention of the audience
increase the flow of information to the audience
achieve clarity and precision

The simpler and the clearer, the better

Text or Figures on the screen?

Text can be used judiciously to present some major concepts

outlines
simple lists
hypothesis
conclusions

Use single words, brief phrases
Never reproduce your speech on the slide
Do not try to make your audience read text when they are supposed to be listening to you

Most things you want to communicate are better done with pictures

methods
anatomy
data
mechanisms
relationships

Can your text be turned into a picture?

Composition

A consistent visual theme looks professional, well thought out.
Choose colors for contrast, clarity, aesthetic appeal
Prepackaged PowerPoint designs are distracting, amateurish.

Figures from papers are often too complicated - simplify!
    eliminate figure legend

Tables

Tables are an accurate way to bring together several different kinds of data
Tables are often too complicated to go through during a talk
Convert tables into simple graphs

Graphs

A wide variety of graphic data presentation formats is available.
The best graphs are simple and easy to read
    use few graphs, make them large.
It is easier to read several graphs side by side than one complicated one

<u>General rules for using graphs as visual aides:</u>

Kip it simple - strip away anything non-essential.
Too much information?
    break it into several graphs
    use PowerPoint to successively add information.

Choose appropriate text sizes. Use a sans serif font (i.e. Arial, Helvetica).
Use all available space.
Make the axis range the same for all comparable graphs.
Be consistent from graph to graph (make a template, then substitute data).

No figure legends.
Minimal titles.
Use color to make different plots more obvious.
Use PowerPoint features to direct the audience's attention

Drawings

Drawings which illustrate a method are usually clearer than a photograph.
    apparatus
    anatomy
    surgical approach

You can't draw with a mouse.
You can draw with a marker!
    draw bold, simple images on white paper with color Sharpies
    scan
    for variation, alter drawing, rescan
    touch up with Photoshop
    change white background to clear!
    add text last

You can draw with preformed lines, boxes, circles, etc
- draw something once, reproduce it
- use the "duplicate" tool to achieve consistency
- use "nudge" and "alignment" tools

Keep it simple

Flow charts, molecular interaction diagrams

Easy to use computer generated squares, circles, arrows
- keep it simple
- complex ideas can be developed by sequential addition of elements

Photographs

Beautiful photographs make a very positive impression.
Poor photographs make a very negative impression.

Use minimal arrows to direct audience attention

Conclusions

A simple list (tell them what you just told them)
- can you limit it to 3 - 4 items?
- use as few words as possible

Acknowldegements

Keep your acknowledgements specific

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Always acknowledge financial support

- Kidney Foundation Fellowship
- Canadian Institutes of Health Research

Do not spend more than 20 seconds on acknowledgements
If pressed for time, put up the acknowledgement slide while asking "Any questions?"