Technical Writing:
How to translate data into a written presentation of your findings

Goals of Technical Writing

Technical Writing is a highly specialized way of writing for technical audiences. The goal in writing a technical report is readability (not self expression).

Readability means:
- Clear, simple prose that is not laden with jargon or vague expressions
- Standard format so it is easy to locate data and compare experiments (methods, etc.)
- Appropriate use of technical vocabulary
- Effective document design and use of figures
- Completeness

Why use a standard format?
- Easy to write? No
- Easy to read? Yes. Optimized for reading
- Good for science: disciplined approach to presentation forces writer to separate results from opinions.
Step 1: Organize your data

Start with figures:
- Assemble hard copies of your figures in a “storyboard”
- Figure out the major technical theme of the report
- Assess how each figure contributes to the major theme
- REVISE figures to focus on the major theme (develop figures that summarize that major theme)

Step 2: Locate trends in data

![Graph showing trends in data]
Step 3: Draft the “story board”

- Integrate figures into a ‘story-board’
- Revise bullet points to better fit story-board
- Add figures to fill in gaps
- Remove figures to eliminate redundancy
Sample Image
- circles are distance markers (250 μm)
- blue dye in left channel, none in right
- blurring of dye in center → diffusion

Characterizing Concentrations
- line = brightness through center row
- brightness ↑ where dye ↓
- measure width from min, max, and slope

Changes with Mixing Distance
- tabulate blurring statistics
- frames separated by 1 mm

Width Vs. Mixing Distance
- log-log plot of w versus d
  - w ∝ d → consistent with theory
  - w ∝ d² → “edge effects”?

Background
- influx A
- influx B

Methods

Results

Discussion
- Developed Theory
- Showed Methods
- Showed Results
- Future Work
Step 4: Start Writing

- Divide the work based on each team member’s skills
- If you divide the writing process, use the following division

  writer 1: Methods + Results

  writer 2: Introduction + Discussion

  together: Conclusion, Title, Abstract, TOC, References, proofreading

- REVISE: read each other’s sections and modify to build coherency.
The best reports:
  - Introduce a topic
  - Describe results of research on the same topic
  - Discuss how the research advances the same topic
  - Describe only methods actually used to determine results

Results

- DESCRIBES but does not interpret the major findings of experiment.
- Tables provide small samples of raw or numerical data.
- Graphs show trends in results.
  Describe those trends in a short text description before the figure.
- Negative results are results and are worth including in your report.
3.1 Brightness contours.

Figure 2 illustrates the effect of dye on brightnesses measured from images of the microfluidics chamber. The right portion of the profile shows the portion of the image that corresponds to the fluid-filled region. The left part of the fluid-filled region contains blue dye. The right part contains no dye. The presence of the dye clearly attenuates the brightness of the blue pixels. Furthermore, there is a gentle transition in blue brightness in the center portion of the fluid-filled region. Straight lines were fit to the center portion of the data to characterize the steepness of this transition, and results for a series of adjacent images are shown in Figure 3.

Figure 2: Sample brightness profiles. Each line in this plot shows brightness as a function of distance across the image through the center row of pixels. Each line shows results for a different color: blue indicates red pixels, magenta indicates green pixels, and yellow represents green pixels.
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![Figure 2: Sample brightness profiles. Each line in this plot shows brightness as a function of distance across the image through the center row of pixels. Each line shows results for a different color: blue indicates red pixels, magenta indicates green pixels, and yellow represents green pixels.](image)
Methods
The Methods section describes your approach taken in your experiment.

- Organized topically
- Detailed thoroughly such that a reader could reproduce your experiment.

3.1 Laboratory Setup
The laboratory setup consisted of a laminar flow chamber and video microscope as described in the lab manual [1]. The width of the channels was 500 μm and the thickness was 100 μm. ...

3.2 Experimental Procedure
The diffusivities of three food colorings (red #2, blue #6, and green #5) were measured in separate experiments. For each experiment, one input reservoir was filled with food coloring and the other was filled with deionized water. ...

3.3 Data Collection
Images were obtained using the camscope program. The laminar flow chamber was oriented so that the direction of fluid motion was vertical. Static images were obtained to characterize ... Sequences of images were obtained ...

3.4 Data Analysis
Images were analyzed to determine fluid velocities and diffusivities as follows.

3.4.1 Fluid Velocity
Fluid velocities were measured by tracking the motions of microspheres ...

3.4.2 Diffusivity
Concentration profiles along the horizontal direction were constructed by averaging the blue intensity for all the pixels in a column and then plotting that average for each horizontal position as a function of horizontal position. Gradients were calculated from concentration profiles using a regression technique implemented with MATLAB. ... (more details) ...
Discussion

The Discussion offers your interpretations and conclusion about your findings.

- Use evidence from the Results to support your discussion.
- Explain limitations, questions left unanswered, major experimental constraints, lack of correlation, negative results.
- How do your results relate to the goals of the study? (See your Introduction)
- How do your results relate to the background information obtained in lectures, textbooks, or outside readings?

5. Discussion.
Images of dyes flowing through microfluidic chambers were analyzed to determine the diffusivities of the dyes. Our results suggest that such measurements can be quite accurate, but that care must be taken to avoid a number of potential problems. These potential problems are discussed in this section.

5.1 Effect of side-walls on measured diffusivities.
Results from section 4.3 show two distinct trends. For short diffusion times, the transition width increases with the square root of time. However, for long diffusion times, the transition width increases with the square of time. The first trend is consistent with predictions of the diffusion equation, while the second is not. We suggest that the second trend results because of edge effects due to the side-walls of the microfluidic channels. This suggestion is consistent with the fact that the measured transition width was nearly as large as the channel width for long diffusion times. However, there are a number of other possible explanations as well. For example, it is also true that the fluid velocity was more nearly uniform near the center of the channel than it was near the edge. Perhaps the fluid velocity also affected diffusive mixing. It may be possible to test these explanations more directly by repeating measurements of this time in chambers with different widths. Alternatively, both of these effects could be studied using numerical simulations. Such simulations could provide better tools for analysis of data taken from microfluidic systems.

5.2 Effect of non-uniform illumination.
Our control in section 4.5 indicate differences in diffusivities for flows using the same dye. These differences suggest that factors other than diffusivity must affect...
Introduction

The Introduction (< 1 page) offers a rationale for your study.

- What is the problem you want to address?
- How does this experiment relate to other research?

Prior research

Problem not addressed or issue furthered

Your approach.
Purpose statement needed; Hypothesis statement optional

More than any other single factor, bulk fabrication has made possible today’s vast array of power and inexpensive electronic devices. The millions of components in a modern computer are fabricated in parallel, making the manufacture of such integrated circuits little more costly than the manufacture of circuits that contain dozens of components. Similar bulk fabrication techniques are currently being developed for fluidic devices, and the resulting microfluidic devices hold promise to similarly revolutionize chemical and biochemical analysis systems.

In this report, we described experiments to measure the diffusivity of a dye. Fluid containing dye made to flow adjacent to fluid that does not contain the dye in “laminar flow” chambers. Mixing of the two solutes is measured using a video microscope. The diffusivity of the dye is determined by analyzing mixing at different locations in the chamber. Measured results are in good agreement with measurements using macroscopic methods.

Microfabrication holds potential to revolutionize the way chemical and biochemical analyses are performed. Because the spatial dimensions can be much smaller than conventional assay equipment, measurements in micro-chambers can be much faster. However, microsystems also introduce additional sources of error. In this report, we compare measurements of diffusivity of a dye using a microfabricated laminar flow chamber and using a glass capillary. While the laminar flow measurements were typically completed in just a few minutes, those with the glass capillary took hours. However, the measurements with the glass capillary agreed with published data to within 10%, while those with the laminar flow chamber were different by a factor of 3. Several potential sources for these errors are analyzed and discussed.
Conclusion
The Conclusion summarizes the results of your research and study limitations. Suggest further research, if appropriate.

Step 5: Add Front/End Matter

Title
Abstract
Table of Contents

Acknowledgements
References
Appendices

Introduction  Theory  Methods  Results  Discussion  Conclusion
Title

- Informative, specific, understandable at a glance
- “The Effect of . . ” titles are usually not specific because they do not isolate the variable you are testing or the effect you observed.

SAMPLE TITLES (some good, some bad . . .which are they?)

- Microfluidics Laboratory Report
- Effect of Channel Width in Measurements of Dye Diffusivity Using Laminar Flow Chambers
- Inhibition of the Diffusion of Dyes by Addition of Glucose
- Nonlinear Mixing During Laminar Flow: Deviations from Fick’s Law

Abstract

The abstract is a 1 paragraph (approximately 150 words) summary of the report, including the summary of methods used, principal results obtained, and conclusions.

SAMPLE ABSTRACT

It is generally assumed that the mixing of solutes during flows in microchannels is governed by diffusion alone. To test this assumption, two streams of water were flowed next to each other in laminar flow chambers with widths of 500 micrometers and thicknesses of 100 micrometers. Different size microspheres (1 and 2 micrometer diameter) were dispersed in each of the two streams. Mixing of the two fluids was assessed by mixing of the different diameters. Results showed an apparent diffusivity of approximately $3 \times 10^{-4}$ cm$^2$/s, which far exceeds that which could be attributed to diffusion. Analysis of flow patterns revealed by tracking the positions of microspheres as a function of time suggest that non-uniformities in the channel walls could contribute to this unexpected mixing. Experiments with different size beads gave similar results. However, experiments with different concentrations of beads showed different levels of unexpected mixing, suggesting that the microspheres may themselves contribute to mixing.
End Matter

Acknowledgements
Give credit to anyone who helped you with your research.

Works Cited
IEEE Style

Appendices
- Notes taken during lab session
- Final proposal
- Copy of your critique of peer report
- Peer critique of your report
- Technical staff critique of your report
- Writing staff critique of your report

Step 6: Edit & Proofread

- Edit for completeness
  Is all relevant information included?
  Where might readers have questions?

- Edit for organization and document design
  Is each section divided logically using subheadings?
  Does the information link clearly across sections?
  Do the figures support the text?

- Edit for prose style
  Are there irrelevant sentences, sections, plots?
  Can you read the report aloud without verbally stumbling?