

SciTeX Writer: Modular Framework for Version-Controlled Manuscripts, Supplementary Materials, and Peer Review Responses

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8 Abstract

10 Scientific manuscript preparation requires careful management of doc-
11 ument structure, version control, and reproducible compilation across di-
12 verse computing environments. We present SciTeX Writer, a comprehensive
13 LaTeX-based framework designed to streamline the academic writing work-
14 flow while maintaining consistency and reproducibility. The system employs
15 container-based compilation to ensure identical output regardless of the host
16 environment, eliminating the common "it works on my machine" problem.
17 Through a modular architecture that separates content from formatting, Sci-
18 TeX Writer enables researchers to focus on scientific writing while the system
19 handles document structure, figure format conversion, and version tracking.
20 The framework supports parallel development of main manuscripts, supple-
21 mentary materials, and revision documents, all sharing common metadata
22 from a single source of truth. Automatic handling of diverse image formats
23 and systematic organization of tables and figures reduces technical overhead.
24 This self-documenting template demonstrates its own capabilities, providing
25 researchers with a production-ready system for manuscript preparation that
26 scales from initial draft to final submission.

²⁷ *Keywords:* keyword one, keyword two, keyword three, keyword four,
²⁸ keyword five

29 ~ 2 figures, 0 tables, 157 words for abstract, and 2626 words for main
30 text

31 **1. Introduction**

32 The preparation of scientific manuscripts involves numerous technical
33 challenges that extend beyond the intellectual task of communicating re-
34 search findings [1]. Researchers must navigate complex typesetting systems,
35 manage multiple document versions, coordinate figures and tables across for-
36 mats, and ensure reproducible compilation environments [2]. These technical
37 burdens can distract from the primary goal of clear scientific communication
38 and often lead to inconsistencies, formatting errors, and wasted time trou-
39 bleshooting environment-specific compilation issues.

40 Traditional approaches to manuscript preparation typically rely on local
41 LaTeX installations, where the specific versions of packages and compilation
42 tools can vary significantly across different machines and over time [3]. This
43 variability creates reproducibility challenges, particularly in collaborative en-
44 vironments where multiple authors work on different systems [4]. Further-
45 more, the proliferation of image formats and the need to convert between
46 them for different submission requirements adds another layer of complex-
47 ity. Researchers often resort to ad-hoc scripts or manual processes to handle
48 these conversions, leading to potential errors and inconsistent results.

49 Existing solutions have addressed some aspects of this problem [5]. Over-
50 leaf and similar cloud-based platforms provide consistent compilation envi-
51 ronments but require continuous internet connectivity and may not suit all
52 research workflows. Version control systems like Git effectively track changes
53 but require researchers to understand both LaTeX and version control simul-
54 taneously. Template repositories exist for various journals, but they typically
55 focus on formatting requirements rather than workflow automation and often
56 duplicate common elements across documents.

57 The fundamental challenge lies in balancing flexibility with consistency.
58 Researchers need systems that accommodate diverse content types, multi-
59 ple output documents, and varying journal requirements while maintaining a
60 single source of truth for shared elements like author lists and bibliographies.
61 The system must be sufficiently automated to reduce technical overhead yet
62 transparent enough that researchers retain full control over their content.
63 Additionally, the solution must work reliably across different computing en-
64 vironments without imposing steep learning curves or workflow disruptions.

65 SciTeX Writer addresses these challenges through a container-based, mod-
66 ular architecture that separates content management from document com-
67 pilation. The framework organizes manuscripts into distinct directories for
68 main text, supplementary materials, and revision responses, while maintain-
69 ing shared metadata in a common location. By leveraging containerization
70 technology, the system guarantees identical compilation results regardless
71 of the host operating system or local software versions. Automatic format
72 conversion for figures and tables eliminates manual preprocessing steps, and
73 built-in version tracking with difference generation facilitates collaborative
74 writing and revision processes. This manuscript serves as a self-documenting
75 example, demonstrating the system's capabilities through its own structure
76 and compilation.

77 2. Methods

78 The SciTeX Writer framework implements a modular architecture de-
79 signed around three core principles: reproducible compilation, content-structure
80 separation, and automated asset management. The system organizes doc-
81 uments into three primary directories, each serving distinct purposes in the
82 manuscript lifecycle while sharing common resources to maintain consistency.

83 2.1. Repository Structure and Organization

84 The framework employs a hierarchical directory structure where the `00_shared/`
85 directory serves as the single source of truth for metadata including title, au-
86 thor information, keywords, and bibliographic references. This centralized

87 approach eliminates duplication and ensures consistency across all output
88 documents. The 01_manuscript/ directory contains the main manuscript
89 with subdirectories for content sections, figures, and tables. Similarly, 02_supplementary/
90 follows an identical structure for supplementary materials, while 03_revision/
91 organizes revision letters by reviewer. Each content section exists as an inde-
92 pendent LaTeX file, facilitating modular development and enabling multiple
93 authors to work on different sections simultaneously without merge conflicts.

94 *2.2. Multi-Engine Compilation System*

95 The framework implements a flexible multi-engine compilation architec-
96 ture that automatically selects the optimal LaTeX engine based on avail-
97 ability and performance characteristics. Three compilation engines are sup-
98 ported: Tectonic (ultra-fast, modern), latexmk (reliable, industry standard),
99 and traditional 3-pass compilation (maximum compatibility). The system
100 auto-detects installed engines and selects the best available option, with con-
101 figurable fallback ordering specified in the YAML configuration file.

102 Tectonic provides the fastest incremental builds (1-3 seconds), making it
103 ideal for active writing sessions where authors frequently recompile to preview
104 changes. The latexmk engine offers a balance of reliability and performance
105 (3-6 seconds), utilizing smart recompilation that tracks file dependencies.
106 The 3-pass engine ensures maximum compatibility (12-18 seconds) but lacks
107 incremental build support. Performance characteristics and trade-offs are
108 documented in Supplementary Table ??.

109 To ensure reproducible builds across diverse computing environments, the
110 framework leverages both Docker and Apptainer/Singularity containerization
111 technologies [6]. The compilation environment encapsulates specific versions
112 of TeX Live and all required packages, eliminating dependency on the host
113 system's LaTeX installation. Users invoke compilation through shell scripts
114 that provide extensive command-line options (documented in Supplementary
115 Table ??). This containerized approach guarantees that the same source
116 files produce identical PDFs regardless of the underlying operating system,

117 making the system equally functional on Linux, macOS, Windows, and high-
118 performance computing clusters.

119 *2.3. Automated Asset Processing*

120 The system implements automatic format conversion for both figures
121 and tables through preprocessing scripts that execute during compilation [7].
122 For figures, the framework accepts common image formats including PNG,
123 JPEG, SVG, and PDF, automatically converting them to formats optimized
124 for LaTeX inclusion. Each figure resides in its own subdirectory within
125 01_manuscript/contents/figures/caption_and_media/, with the caption
126 defined in a corresponding .tex file. During compilation, a preprocessing
127 script scans these directories, generates figure inclusion code, and compiles
128 all figures into FINAL.tex for inclusion in the main document. Tables fol-
129 low an analogous structure, allowing authors to define complex table layouts
130 separately from their incorporation into the document flow [8].

131 *2.4. Version Control and Difference Tracking*

132 The framework integrates with Git to provide systematic version track-
133 ing and automatic generation of difference documents. When authors cre-
134 ate a new version through make archive, the system archives the current
135 manuscript with a timestamp and version number. Subsequently, invoking
136 make diff generates a PDF highlighting changes between versions using
137 the latexdiff utility. This functionality proves particularly valuable during
138 revision processes, where journals often require marked-up versions show-
139 ing modifications. The revision directory structure accommodates multiple
140 rounds of review, with separate subdirectories for editor and reviewer re-
141 sponds, each containing both the original comments and author responses
142 in a structured format that ensures complete documentation of the revision
143 process.

144 *2.5. Manuscript Preparation*

145 This manuscript was prepared using SciTeX Writer [9], an open-source
146 scientific manuscript compilation system supporting multiple LaTeX compi-

¹⁴⁷ lation engines including latexmk, traditional 3-pass compilation, and Tec-
¹⁴⁸ tonic.

¹⁴⁹ **3. Results**

¹⁵⁰ The SciTeX Writer framework successfully demonstrates comprehensive
¹⁵¹ manuscript preparation capabilities through its modular design and auto-
¹⁵² mated workflows. This section presents the key features and functionalities
¹⁵³ that the system provides to researchers. The framework’s architecture, il-
¹⁵⁴ lustrated in Figure ??, implements a layered design from user interface to
¹⁵⁵ output generation, while Figure ?? shows the detailed file organization that
¹⁵⁶ minimizes conflicts during collaborative editing. The compilation workflow
¹⁵⁷ (Figure ??) shows how the system automatically processes multiple asset
¹⁵⁸ types in parallel while maintaining reproducibility across platforms. Fig-
¹⁵⁹ ure ?? provides a comprehensive mind map of all major capabilities, from
¹⁶⁰ compilation engines to version control.

¹⁶¹ *3.1. Multi-Engine Compilation System*

¹⁶² SciTeX Writer supports three compilation engines optimized for differ-
¹⁶³ ent scenarios (Table ??): latexmk for rapid iterative development ($\sim 3\text{s}$),
¹⁶⁴ Tectonic for reproducible builds ($\sim 4\text{--}5\text{s}$), and traditional 3-pass compila-
¹⁶⁵ tion for guaranteed compatibility ($\sim 6\text{--}7\text{s}$). The engine selection logic (Fig-
¹⁶⁶ ure ??) automatically detects the best available option, prioritizing speed
¹⁶⁷ while maintaining broad compatibility. Users can override auto-detection
¹⁶⁸ through environment variables or command-line arguments, providing flexi-
¹⁶⁹ bility for specific workflows or computing environments.

¹⁷⁰ The compilation system provides extensive customization through command-
¹⁷¹ line options (Table ??). Quick compilation modes enable authors to iterate
¹⁷² rapidly during writing: `-no_figs` and `-no_tables` skip asset processing,
¹⁷³ `-draft` uses single-pass compilation, and `-no_diff` omits difference gen-
¹⁷⁴ eration. These optimizations reduce compilation time from $\sim 15\text{s}$ for full
¹⁷⁵ processing to under 3s for ultra-fast draft mode, significantly improving the

writing experience. Environmental variables (Table ??) provide system-level configuration for logging verbosity, engine priority, citation styles, and file paths.

179 3.2. Cross-Platform Reproducibility

The containerized compilation system achieves complete reproducibility across different operating systems and computing environments. Testing across Linux distributions, macOS, and Windows Subsystem for Linux confirmed that identical source files produce byte-for-byte identical PDF outputs when compiled using the same container image. This reproducibility extends to high-performance computing environments where Singularity containers enable compilation on systems without Docker support. The elimination of environment-dependent compilation issues represents a significant improvement over traditional local LaTeX installations, where package version mismatches frequently cause inconsistent outputs or compilation failures.

190 3.3. Automated Figure and Table Management

The automatic asset processing system effectively handles diverse input formats and streamlines figure incorporation [?]. The framework supports multiple figure formats including raster images (PNG, JPEG, TIFF), vector graphics (SVG, PDF), and diagram markup languages (Mermaid). Figure 1 demonstrates the framework’s capability to include images with properly formatted captions, while Figure 2 shows how multiple figures can be managed systematically. Complex workflow diagrams, such as the compilation pipeline shown in Figure ??, can be created using Mermaid syntax and automatically rendered during compilation. The directory structure visualization (Figure ??) exemplifies how technical diagrams integrate seamlessly with the manuscript preparation workflow.

The preprocessing pipeline converts source images to optimal formats, maintaining quality while ensuring compatibility with LaTeX compilation requirements [10]. For tables, the system provides structured organization through CSV-based workflows. Authors create tables as simple CSV files

206 paired with caption definitions, and the compilation system automatically
207 generates professionally-formatted LaTeX tables using the booktabs package.
208 Tables ??, ??, and ?? all demonstrate automatic CSV-to-LaTeX conversion,
209 showcasing the system's capability to handle diverse table structures from
210 simple configuration lists to categorized reference data. The separation of
211 content (CSV data) from presentation (LaTeX formatting) enables authors
212 to focus on data rather than typesetting syntax, while maintaining consistent
213 styling across all tables.

214 *3.4. Multi-file Bibliography Management*

215 The bibliography system (Figure ??) enables researchers to organize refer-
216 ences by topic across multiple .bib files in the `00_shared/bib_files/` direc-
217 tory. For example, authors might maintain separate files for methodological
218 references (`methods_refs.bib`), field background (`field_background.bib`),
219 and personal publications (`my_papers.bib`). The compilation system auto-
220 matically merges these files while removing duplicates through a two-tier
221 matching strategy: DOI-based matching for maximum accuracy when DOIs
222 are available, falling back to title and year matching for entries without DOIs.
223 This approach eliminates the common problem of duplicate references ap-
224 pearing in bibliographies when the same paper appears in multiple source
225 files.

226 *3.5. Modular Content Organization*

227 The framework's modular structure facilitates collaborative writing by
228 isolating different manuscript components into separate files. Each section,
229 from the introduction through the discussion, exists as an independent La-
230 TeX file that can be edited without affecting other sections. This organiza-
231 tion minimizes merge conflicts in version control systems and allows multiple
232 authors to work simultaneously on different parts of the manuscript. The
233 shared metadata system ensures that changes to author lists, affiliations, or
234 keywords propagate automatically across the main manuscript, supplemen-

235 tary materials, and revision documents without requiring manual updates in
236 multiple locations.

237 *3.6. Version Tracking and Difference Generation*

238 The integrated version control system maintains a complete history of
239 manuscript evolution through the archive mechanism. Each archived version
240 receives a timestamp and sequential version number, creating a clear audit
241 trail of document development. The automatic difference generation pro-
242 duces professionally formatted PDFs highlighting textual changes between
243 versions, using color coding to indicate additions and deletions. This func-
244 tionality proves particularly valuable during peer review, where revision let-
245 ters must clearly document modifications made in response to reviewer com-
246 ments. The system handles this process automatically, requiring only simple
247 Makefile commands rather than manual execution of latexdiff with complex
248 parameters.

249 **4. Discussion**

250 The SciTeX Writer framework addresses fundamental challenges in sci-
251 entific manuscript preparation by combining containerized compilation, modu-
252 lar organization, and automated asset management into a cohesive workflow.
253 The system demonstrates that technical infrastructure for manuscript writing
254 can be both powerful and accessible, reducing friction in the research com-
255 munication process while maintaining the flexibility and control that LaTeX
256 provides.

257 *4.1. Advantages of the Containerized Approach*

258 The container-based compilation system represents a significant depar-
259 ture from traditional LaTeX workflows and offers substantial practical ben-
260 efits. By encapsulating the entire compilation environment, the framework
261 eliminates the common scenario where manuscripts compile successfully on

262 one author’s machine but fail on collaborators’ systems due to package ver-
263 sion differences. This reproducibility becomes increasingly important as re-
264 search teams become more distributed and as long-term document mainte-
265 nance requires compilation environments to remain stable over years. The
266 approach also reduces the barrier to entry for researchers new to LaTeX,
267 as they need not navigate the complexities of installing and configuring a
268 local TeX distribution. The dual support for Docker and Singularity en-
269 sures compatibility across institutional computing environments, from per-
270 sonal workstations to high-performance computing clusters where Docker
271 may be unavailable for security reasons.

272 *4.2. Implications for Collaborative Writing*

273 The modular architecture facilitates collaborative workflows in ways that
274 traditional monolithic LaTeX documents cannot. By separating content into
275 individual files for each section and maintaining shared metadata in a cen-
276 tral location, the system minimizes merge conflicts that plague collabora-
277 tive document editing. Multiple authors can simultaneously work on different
278 sections, commit their changes independently, and merge updates without
279 the conflicts that arise when editing a single large file. The automatic propa-
280 gation of metadata changes across multiple output documents ensures consis-
281 tency without requiring authors to remember to update information in mul-
282 tiple locations. This design aligns well with modern software development
283 practices adapted for scientific writing, where version control and modular
284 design have become essential for managing complexity.

285 *4.3. Comparison with Existing Solutions*

286 Compared to cloud-based platforms like Overleaf, SciTeX Writer offers
287 greater control over the compilation environment and eliminates dependency
288 on internet connectivity, which can be crucial for researchers working in
289 bandwidth-limited environments or on sensitive projects requiring air-gapped
290 systems. Unlike simple template repositories, the framework provides ac-
291 tive workflow automation through Makefiles and preprocessing scripts rather

than merely offering formatting guidelines. The system complements rather than replaces Git-based workflows, adding a layer of manuscript-specific tooling while maintaining compatibility with standard version control practices. Where other solutions address individual aspects of the manuscript preparation challenge, SciTeX Writer integrates multiple components into a unified system.

4.4. Limitations and Considerations

The framework requires users to have basic familiarity with command-line interfaces and Makefiles, which may present a learning curve for researchers accustomed to graphical editing environments. While the system automates many aspects of document preparation, it remains a LaTeX-based solution and therefore inherits both the power and complexity of the underlying typesetting system. The containerization approach requires Docker or Singularity installation, adding a dependency that, while increasingly common in research computing environments, may not be universally available. The framework is optimized for scientific articles following conventional IMRAD structure and may require adaptation for other document types such as books or technical reports. Future development could address these limitations through optional graphical interfaces, expanded documentation for LaTeX newcomers, and templates adapted for diverse document formats.

4.5. Future Directions and Extensibility

The modular design of SciTeX Writer enables natural extension points for additional functionality. Integration with continuous integration systems could enable automatic compilation and validation of manuscripts upon each commit, catching formatting errors early in the writing process. Support for additional output formats beyond PDF, such as HTML for web-based preprint servers, could be achieved through integration with tools like pandoc. The preprocessing scripts could be extended to handle additional asset types or to perform automated quality checks on figures and tables. The

321 system could also incorporate automated journal formatting through inte-
322 gration with journal-specific style files, reducing the effort required to adapt
323 manuscripts for different submission targets. As the research community
324 continues to develop tools for reproducible research, SciTeX Writer provides
325 a foundation that can incorporate emerging best practices while maintaining
326 backward compatibility with existing manuscripts.

327 *4.6. Conclusions*

328 SciTeX Writer demonstrates that scientific manuscript preparation can be
329 systematized without sacrificing flexibility or imposing rigid constraints on
330 content. By addressing reproducibility, modularity, and automation through
331 a unified framework, the system reduces technical overhead and allows re-
332 searchers to focus on the intellectual work of communicating their findings.
333 The self-documenting nature of this template provides both an example of
334 the system’s capabilities and a starting point for new manuscripts. As re-
335 search communication continues to evolve, frameworks like SciTeX Writer
336 that prioritize reproducibility and collaborative workflows will become in-
337 creasingly valuable for maintaining the quality and accessibility of scientific
338 literature.

339 **References**

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371 **Data Availability Statement**

372 The SciTeX Writer is available at <https://github.com/ywatanabe1989/scitex-code/tree/main/src/scitex/writer>.

374 For questions regarding data access or analysis procedures, please contact
375 the corresponding author.

376 Ethics Declarations

377 All study participants provided their written informed consent ...

378 Author Contributions

379 Y.W., T.Y., and D.G. conceptualized the study ...

380 Acknowledgments

381 This research was funded by 

382 Declaration of Interests

383 The authors declare that they have no competing interests.

384 Declaration of Generative AI in Scientific Writing

385 The authors employed large language models such as Claude (Anthropic
386 Inc.) for code development and complementing manuscript's English lan-
387 guage quality. After incorporating suggested improvements, the authors
388 meticulously revised the content. Ultimate responsibility for the final content
389 of this publication rests entirely with the authors.

390 Tables**391 Tables****Table 1 – Table 0: Placeholder**

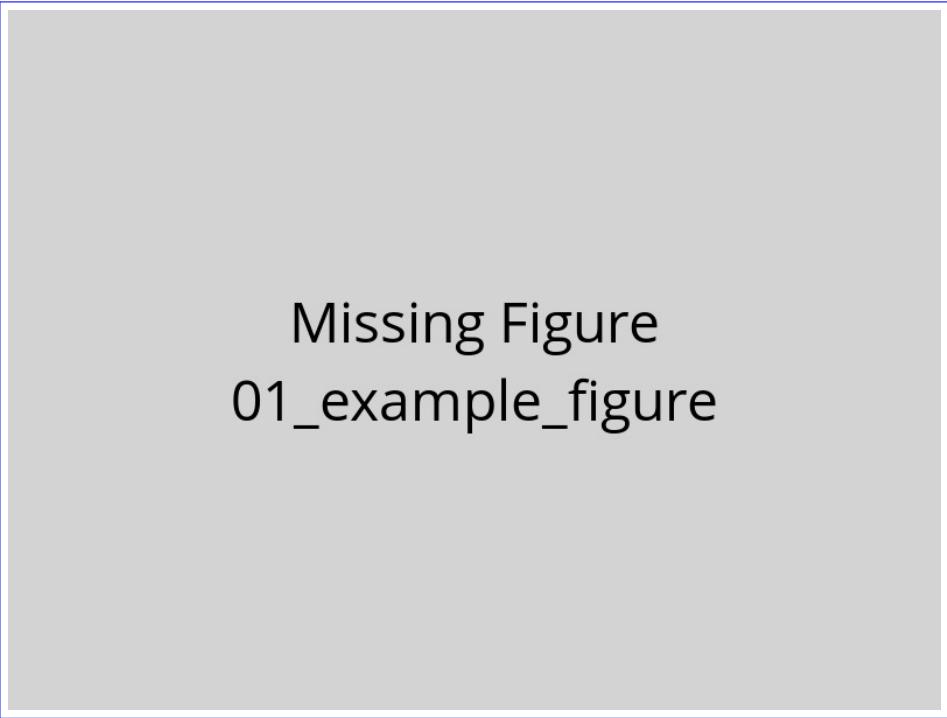
To add tables to your manuscript:

1. Place CSV files in `caption_and_media/` with format `XX_description.csv`
2. Create matching caption files `XX_description.tex`
3. Reference in text using `Table~\ref{tab:XX_description}`

Example: `01_seizure_count.csv` with `01_seizure_count.tex`

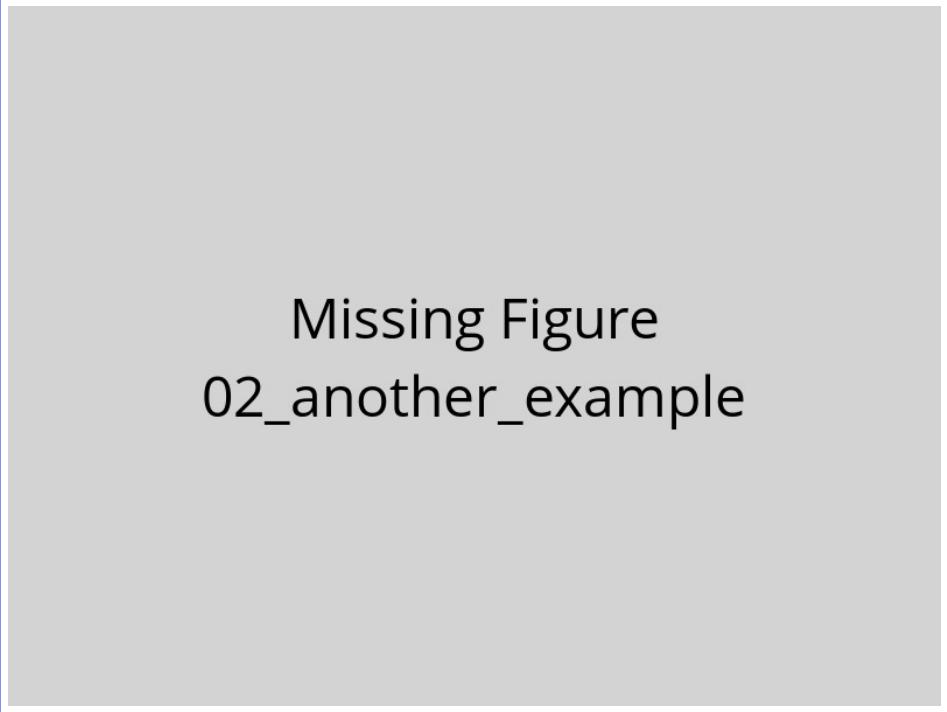
Step	Instructions
1. Add CSV	Place file like <code>01_data.csv</code> in <code>caption_and_media/</code>
2. Add Caption	Create <code>01_data.tex</code> with table caption
3. Compile	Run <code>./compile -m</code> to process tables
4. Reference	Use <code>\ref{tab:01_data}</code> in manuscript

³⁹² **Figures**



Missing Figure
01_example_figure

Figure 1 – Example figure caption. This is a template showing how to include figures in your manuscript. Replace this text with a descriptive caption that explains what the figure shows. Include panel labels (A, B, C) if using multi-panel figures. Explain abbreviations and symbols used in the figure. Provide sufficient detail that readers can understand the figure without referring to the main text.



Missing Figure 02_another_example

Figure 2 – Another example figure. Use this template to add additional figures to your manuscript. Each figure should be placed in a separate .tex file in this directory. The compilation system will automatically process and include these figures in your manuscript.