PNAS Information for Authors

REVISED September 2019

PNAS welcomes submissions from top researchers across the Physical, Social, and Biological sciences. Each year, we receive more than 16,000 Direct Submissions and publish more than 3,200 articles. An NAS member makes the final decision for each paper; accepted papers are of exceptional scientific importance and intelligible to a broad scientific audience. Our acceptance rate for Direct Submissions is 14%. **Only a single PDF file containing all text, figures, tables, and supporting information (SI) is required for initial submissions; high-resolution files are not required.**

In 2018, 62% of PNAS articles were by authors outside the United States, reflecting the global nature of high-impact scientific research.

PNAS is format-neutral at first submission. Manuscripts do not need to be formatted according to journal-specific guidelines at this stage.

PNAS has rapid turn times. The average time to first decision is 21 days; articles may be published as soon as 4–5 weeks after acceptance.

PNAS supports open access. We offer an immediate open access option, CC BY and CC BY-NC-ND licenses, preprint server integration, and compliance with funder mandates worldwide.

PNAS is currently seeking exceptional work in the Physical and Social Sciences. Learn more in our Call for Papers.

All individuals participating in PNAS activities as editors, authors, or reviewers must adhere to the NAS Policy on Discrimination, Harassment, and Bullying for Participants in Academies Activities.

PNAS is committed to transparency in its editorial review process. As a member of the Committee on Publication Ethics (COPE), PNAS supports its core practices.

PURPOSE AND SCOPE

PNAS publishes research reports, Brief Reports, Letters, Front Matter magazine content, Commentaries, Perspectives, and Colloquium Papers. We welcome submissions from top researchers in all fields of the Physical, Social, and Biological sciences. In accordance with the guiding principles established by George Ellery Hale in 1914, PNAS also publishes brief first announcements of NAS members' and foreign associates' more important contributions to research and of work that appears to a member to be of particular importance. All submissions are evaluated by a member of the Editorial Board prior to acceptance. PNAS is a general science journal, and all papers should be intelligible to a broad scientific audience.

Article Types

Research reports (Contributed and Direct Submissions) describe the results of original research of exceptional importance and include a Significance Statement that describes the significance of the work. Unsolicited research reports are welcome.

Brief Reports describe observations of immediate impact that may hold potential to initiate new avenues of research, provide compelling new data on controversies of broad interest and long-standing questions, or present a concise conceptual advance. Brief Reports are limited to 18,000–20,000 characters and typically include no more than 2 graphical elements. The character count includes manuscript text, as well as the title page, abstract, references, figure legends, graphical elements (e.g., figures and tables), and spaces. Graphical elements are estimated at 2,000 characters each at initial submission. Supporting information is limited to essential supporting datasets and videos (no additional methods, tables, or figures). Where appropriate, authors are encouraged to cite protocols. Brief Reports receive an accelerated review and production process of ~3 months and are open access. Brief Reports follow the Direct Submission mode of review. Unsolicited Brief Reports are welcome.

Letters are brief comments that allow readers to constructively address a difference of opinion with authors of a recent PNAS article. Readers may comment on exceptional studies or point out potential flaws in studies published in the journal. Letters may not include requests to cite the Letter writer's work, accusations of misconduct, or personal comments to an author. Letters are limited to 500 words and 10 references, and must be submitted within 6 months of the publication of the subject article in *Latest Articles*. Unsolicited Letters are welcome.

Front Matter is an expanded front magazine section that tells the stories of science in interesting ways. Sections include News Features, Science and Culture, Inner Workings, and Core Concepts, all written by science journalists. The section also includes **Opinion** articles. These succinct essays, which are authored by researchers, further the discourse on a topic via a clearly articulated argument armed with novel ideas or proposals. Submissions deemed appropriate are reviewed by an NAS member with the relevant expertise.

Commentaries call attention to articles of particular note and are written only at the invitation of the Editorial Board.

Perspectives present a viewpoint on an important area of research. Perspectives focus on a specific field or subfield within a larger discipline and discuss current advances and future directions. Perspectives are of broad interest to nonspecialists and may add personal insight to a field, but should be balanced and objective. Perspectives are written only at the invitation of the Editorial Board and follow the Direct Submission mode of review.

Colloquium Papers are reports of scientific colloquia held under NAS auspices and are written only at the invitation of the Editorial Board.

All papers are evaluated solely on their scientific merit by peers, not by professional staff editors. A 3-tier review process for research reports includes review by an Editorial Board member from one of the 31 NAS disciplines, an NAS member editor, and independent peer reviewers. NAS member editors are professional scientists and active researchers. A list of Editorial Board members and their disciplines appears on our masthead.

EDITORIAL AND JOURNAL POLICIES

Direct Submission. The standard mode of transmitting manuscripts is Direct Submission. **Authors should submit a single combined PDF in any format or style for initial submissions**.

Manuscripts do not need to be formatted according to specific journal guidelines at this stage. The Editorial Board screens all incoming submissions and may reject manuscripts without further review, or review and reject manuscripts that do not meet PNAS standards. More than 50% of Direct Submissions are declined by the Editorial Board without additional review, within 2 weeks on average. For papers that are sent on to an editor and reviewers, the average time to receive a decision is 45 days. If accepted, authors have their articles published as soon as 4–5 weeks after acceptance.

Authors must recommend 3 appropriate Editorial Board members, 3 NAS members who are expert in the paper's scientific area, and 5 qualified reviewers. The Board may choose someone who is or is not on that list or may reject the paper without further review. Authors should indicate in their cover letter why their suggested editors are qualified to handle the paper and why any nonpreferred reviewers should be excluded. See the directory of PNAS member editors and their research interests. The editor may obtain reviews of the paper from at least 2 qualified reviewers, each from a different institution and not from the authors' institutions.

PNAS manages the review process. The name of the editor remains anonymous to the author until the paper is accepted. Direct Submissions are published as "Edited by" the member editor, who oversees the review but is not the guarantor of the work.

Contributed Submission. A member of the National Academy of Sciences may contribute up to 4 of her or his own manuscripts for publication in PNAS each year. Contributed papers go through open peer review (named reviewers), with the administrative aspects of the review process handled by PNAS. About 25% of articles published in PNAS are contributed. To contribute a paper, the member must affirm that he or she had a direct role in the design and execution of all or a significant fraction of the work, and the subject matter must be within the member's area of expertise. Contributed articles must report the results of original research. Academy members who have a real or perceived competing interest, financial or otherwise, that could be seen to significantly impair their objectivity or to create an unfair competitive advantage for any person or organization tied to the research should consider submitting their work as a Direct Submission. The final version of the paper must be submitted by the last day of the year to count toward that year's annual limit.

Members who have selected at least 2 reviewers should submit information about their manuscript to PNAS, including a PDF file for review and documentation that the reviewers have agreed to review the paper. Each reviewer should be from a different institution and not from the authors' institutions. Reviewers are asked to evaluate revised manuscripts to ensure that their concerns have been adequately addressed.

Members must select reviewers who have not collaborated with the authors in the past 48 months. See section *iv* and our Competing Interest Policy. Members must verify that reviewers are free of competing interests, or must disclose any competing interests and explain their choice of reviewers. The names and institutional affiliations of all reviewers of Contributed articles are published in a footnote. The NAS member must be one of the corresponding authors on the paper. These papers are published as "Contributed by" the responsible editor.

Review. The Direct Submission track has anonymous peer review, and the Contributed track has open peer review (named reviewers). Papers on both tracks go through a 3-tier peer review process. At submission, papers are assigned to an Editorial Board member in one of the 31 NAS disciplines. If the Board member determines that the paper should proceed further, she/he assigns it to a member editor or, if the NAS membership lacks sufficient expertise, to a nonmember guest editor to oversee the peer review process. Member editors and guest editors determine whether the paper should be sent for review; if so, they solicit and evaluate peer reviews and make recommendations to the Editorial Board member, who makes the final decision to accept or reject the paper.

All manuscripts are evaluated by the Editorial Board. The Board may reject manuscripts without further review, or review and reject manuscripts that do not meet PNAS standards. Replication studies are held to the same standards as other submissions. A single negative review for a paper on either track, with which the editor agrees, is sufficient to recommend rejection. Manuscripts rejected by one member cannot be resubmitted through another member or as a Direct Submission. Information about submitted manuscripts or the identity of the assigned Board member is confidential and not shared with authors or third parties. The names of reviewers are also confidential and not shared, unless express permission is granted by the reviewers.

Appeals of decisions on rejected papers will be considered; however, appeals on the basis of novelty or general interest are unlikely to be granted. Due to the high volume of submissions that PNAS receives, a quick decision on appeals cannot be guaranteed. Appeals must be made in writing and should be sent to pnas@nas.edu. If an appeal is rejected, further appeals of the decision will not be considered and the paper may not be resubmitted. Repeated appeals or resubmissions of a rejected manuscript without invitation by the Editorial Board will not be considered and may result in the authors being banned from submitting to PNAS.

Submission Guidelines

(*i*) Papers are considered provided they have not been **Published Previously** or concurrently submitted for publication elsewhere. What constitutes prior publication must take into account many criteria, including the extent of review, and will be determined on a case-by-case basis. Related manuscripts that are in press or submitted elsewhere must be included with a PNAS submission.

Figures, tables, or videos that have been published elsewhere must be identified, and permission of the copyright holder for both the online and print editions of the journal must be provided.

(*ii*) Posting on **Preprint Servers**, such as arXiv or bioRxiv, is permitted and will not affect editorial consideration. However, the license selected for a preprint will affect the sharing, adaptation, and reuse of material (see Licenses for PNAS Articles and the PNAS statements on prior publication and preprints for details, and see section *vii* for media embargo policies).

(*iii*) **Authorship** must be limited to those who have contributed substantially to the work. The corresponding author must have obtained permission from all authors for the submission of each version of the paper and for any change in authorship. Throughout submission and peer review, a single corresponding author is responsible for providing all necessary manuscript information and interactions with the editorial office. After acceptance and publication, multiple corresponding authors, who are responsible for checking the accuracy of the proof contents and who will act as points of contact for queries about the paper, are permissible; they should be indicated in the title page (see *Manuscript Format and Files*).

All collaborators share some degree of responsibility for any paper they coauthor. Some coauthors have responsibility for the entire paper as an accurate, verifiable report of the research. These include coauthors who are accountable for the integrity of the data reported in the paper, carry out the analysis, write the

manuscript, present major findings at conferences, or provide scientific leadership to junior colleagues.

Coauthors who make specific, limited contributions to a paper are responsible for their contributions but may have only limited responsibility for other results. While not all coauthors may be familiar with all aspects of the research presented in their paper, all collaborators should have in place an appropriate process for reviewing the accuracy of the reported results.

Authors must indicate their specific contributions to the published work. This information will be published as a footnote to the paper. Published contributions are taken from the submission system, not from the manuscript file. Examples of designations include:

- Designed research
- Performed research
- Contributed new reagents or analytic tools
- Analyzed data
- Wrote the paper

An author may list more than one contribution, and more than one author may have contributed to the same aspect of the work.

(*iv*) Failure to disclose a **Competing Interest** at submission may result in author sanctions. Authors must disclose, at submission, any association that poses or could be perceived as a competing interest in connection with the manuscript, and acknowledge all funding sources supporting the work. Disclosures must be entered directly into the submission system; providing a link to full disclosures hosted on a website is not permissible. When asked to evaluate a manuscript, members, reviewers, and editors must disclose any association that poses a competing interest in connection with the manuscript.

Recent collaborators, defined as people who have coauthored a paper or were a principal investigator on a grant with any of the authors within the past 48 months, must be excluded as editors and reviewers. Other examples of possible competing interests include past or present association as thesis advisor or thesis student, or a family relationship, such as a spouse, domestic partner, or parent–child relationship. Please see our Competing Interest Policy for details.

(*v*) Regarding **Research Misconduct**, all work should be free of fabrication, falsification, and plagiarism as defined by the US Office of Research Integrity.

PNAS is a member of CrossCheck by Crossref and iThenticate, a plagiarism screening service that checks submissions against millions of published research papers and web pages. PNAS uses this software to screen manuscripts for potential text duplication. PNAS will also evaluate issues with text, data, or figures that are brought to our direct attention. Authors must place direct quotes or excerpts in quotation marks and must identify the original source reference(s). For overlapping passages that are not verbatim, authors must include the original source reference(s). PNAS may discuss the concerns with a member of the Editorial Board, the editor, or the authors. PNAS may request from the authors source data, descriptions of how experiments were performed, or explanations of how figures were prepared. Responses are assessed by subject experts.

In submitting to PNAS, all authors must agree to abide by relevant PNAS policies. Manuscripts are reviewed with the explicit understanding that all authors have seen and approved of the submitted version. In cases of suspected or alleged misconduct, PNAS follows the recommended procedures from COPE.

(*vi*) Completion of the online submission form gives a **License to Publish** the work to the NAS. If a paper is declined for publication, the license to publish is terminated.

(*vii*) PNAS may distribute **Embargoed** copies of an accepted article to the press prior to publication. Embargoes expire at 3:00 PM Eastern time, Monday of the publication week. Authors may talk freely with the press about their work but should coordinate with the PNAS News Office so that reporters are aware of PNAS policy.

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(*viii*) Research involving **Human and Animal Participants and Clinical Trials** must have been approved by the author's institutional review board. Authors must include in the methods section a brief statement identifying the institutional and/or licensing committee approving the experiments. For all experiments involving human participants, authors must also include a statement confirming that informed consent was obtained from all participants, or provide a statement why this was not necessary.

All experiments must have been conducted according to the principles expressed in the Declaration of Helsinki. Authors must follow the International Committee of Medical Journal Editors' policy and deposit trial information and design into an accepted clinical trial registry before the onset of patient enrollment. For animal studies, authors must report the species, strain, sex, and age of the animals.

(*ix*) **Dual Use Research of Concern**. Authors and reviewers must notify PNAS if a manuscript reports potential dual use research of concern. PNAS will evaluate such papers and, if necessary, will consult additional reviewers.

(*x*) For research using **Recombinant DNA**, physical and biological containment must conform to National Institutes of Health guidelines or those of a corresponding agency.

(*xi*) **Materials and Data Availability**. To allow others to replicate and build on work published in PNAS, authors must make materials, data, and associated protocols, including code and scripts, available to readers. Authors should follow the FAIR (findable, accessible, interoperable, and reusable) data principles and deposit data in community-approved public repositories repositories (see the DataCite Repository Finder to search for appropriate repositories). Authors must disclose upon submission of the manuscript any restrictions on the availability of materials or information. Authors must include a data availability statement in the methods section describing how readers will be able to access the data, associated protocols, code, and materials in the paper. Authors are encouraged to deposit laboratory protocols and include their DOI or URL in the methods section of their paper. Data not shown and personal communications cannot be used to support claims in the work.

Authors should deposit as much of their data as possible in community-endorsed publicly accessible databases, and when possible follow the guidelines of the Joint Declaration of Data Citation Principles. If deposition of data is not possible, authors may use supporting information (SI) to show all necessary data. Research datasets should be cited in the references. (See *References* for citation information.) In rare cases where subject-specific repositories are not available, authors may use a general repository such as figshare, Dryad, or Open Science Framework. Fossils or other rare specimens must be deposited in a museum or repository and be made available to qualified researchers for examination.

For further information about accessibility of data and materials, see the following: *Sharing Publication-Related Data and Materials: Responsibilities of Authorship in the Life Sciences* (2003) and *Ensuring the Integrity, Accessibility, and Stewardship*

of Research Data in a Digital Age (2009).

Authors must make **Unique Materials** (e.g., cloned DNAs; antibodies; bacterial, animal, or plant cells; viruses; and algorithms and computer codes) promptly available on request by qualified researchers for their own use. Failure to comply will preclude future publication in the journal. It is reasonable for authors to charge a modest amount to cover the cost of preparing and shipping the requested material. Contact pnas@nas.edu if you have difficulty obtaining materials.

Plasmids: Authors are encouraged to deposit plasmid constructs in a public repository such as Addgene.

Databases: Before publication, authors must deposit large datasets (including microarray data, protein or nucleic acid sequences, and atomic coordinates for macromolecular structures) in an approved database and provide an accession number for inclusion in the published article. When no public repository exists, authors must provide the data as SI or, if this is not possible, on the author's institutional website. Authors should contact PNAS regarding special circumstances or privacy concerns.

Characterization of Chemical Compounds: Authors must provide sufficient information to establish the identity of a new compound and its purity. Sufficient experimental details must be included to allow other researchers to reproduce the synthesis. Characterization data and experimental details must be included either in the text or in the SI.

Protein and Nucleic Acid Sequences: Authors must deposit data in a publicly available database such as GenBank, EMBL, DNA Data Bank of Japan, UniProtKB/Swiss-Prot, or PRIDE and provide a link to the data and associated accession numbers prior to publication.

Structural Studies: For papers describing structures of biological macromolecules and small molecules, the atomic coordinates and the related experimental data (structure factor amplitudes/intensities and/or NMR restraints) must be deposited at a member site of the Worldwide Protein Data Bank: RCSB PDB, PDBe, PDBj, or BMRB prior to publication. The PDB ID should be included in the manuscript. For nuclear magnetic resonance structures, data deposited should include resonance assignments and all restraints used in structure determination and the derived atomic coordinates for both an individual structure and a family of acceptable structures.

Papers must include literature references for all coordinate datasets as well as dataset identification. Authors must agree to release the atomic coordinates and experimental data when the associated article is published. Authors may be asked to provide the atomic coordinates and experimental data during the review process and are encouraged to provide PDB validation reports at submission. Questions relating to depositions should be sent to deposit@wwpdb.org.

For papers describing structures of biological macromolecules from electron microscopy experiments that involve any averaging method (including subtomogram averaging), the 3D map should be deposited at either the EMBL-EBI (UK) or RCSB (USA) EMDB deposition site. Any atomic structure models fitted to EM maps must be deposited in the PDB. For electron tomographic studies with no averaging, deposition of one or more representative tomograms in EMDB is strongly recommended. PDB and/or EMDB accession codes must be included in the manuscript, together with a brief descriptive title for each accession. In cases where PDB models have been fitted into EMDB maps, the correspondences between them should be clearly stated.

For papers describing small-angle scattering experiments, authors are encouraged to follow the guidelines presented by the International Union of Crystallography (IUCr). Prior to submission, authors are encouraged to use the IUCr checkCIF service to validate their crystallographic information files (CIFs) and structure factors. Validation reports may be submitted as SI for editors and reviewers.

Functional Magnetic Resonance Imaging (fMRI) Studies: Authors should deposit data with XNAT Central, or other suitable public repositories.

Genomic and Proteomic Studies: Authors of papers that include genomic, proteomic, or other high-throughput data are required to submit their data to the NCBI gene expression and hybridization array data repository (GEO) or equivalent publicly accessible database and must provide the accession number. Deposition in dbGaP is encouraged. Access to the deposited data must be available at the time of publication. Submitted data should follow the MIAME checklist.

Enzymology Data: Authors should follow the Standards for Reporting Enzymology Data (STRENDA) commission guidelines when reporting kinetic and equilibrium binding data. See the Beilstein Institut/STRENDA commission website for details.

Earth and Space Sciences Data: Authors are encouraged to follow the FAIR data principles (see the DataCite Repository Finder).

Design and Analysis Transparency: Authors should follow field standards for disclosing key aspects of research design and data analysis, and should report the standards used in their study. See the Equator Network for information about standards across disciplines. PNAS encourages authors to preregister their studies and analysis plans and to provide links to the preregistration in their submission.

Statistical Analysis: Authors should include the source and version of any software used, full information on the statistical methods and measures used for each table and figure, such as a statistical test, estimates of parameters, exact sample sizes, and measures of evidence strength (frequentist or Bayesian). Statistical analyses should be done on all available data and not just on data from a "representative experiment." Statistics and error bars should only be shown for independent experiments and not for replicates within a single experiment (see *Figure Legends* for error bar details). Editors may send manuscripts for statistical review.

(*xii*) **Figure Preparation.** No specific feature within an image may be enhanced, obscured, moved, removed, or introduced. The grouping or consolidation of images from multiple sources must be made explicit by the arrangement of the figure and in the figure legend. Adjustments of brightness, contrast, or color balance are acceptable if they are applied to the whole image and if they do not obscure, eliminate, or misrepresent any information present in the original, including backgrounds.

Questions about images raised during image screening will be referred to the editors, who may request the original data from the authors for comparison with the prepared figures. If the original data cannot be produced, the manuscript may be rejected. Cases of deliberate misrepresentation of data will result in rejection of the paper and will be reported to the corresponding author's home institution or funding agency. Authors must obtain consent for publication of figures with recognizable human faces.

(*xiii*) **Supporting Information.** SI enhances articles in PNAS by providing additional substantive material, but the paper must stand on its own merits. SI is reviewed along with the paper and must be approved by the editors and reviewers. SI is posted exactly as the author has provided it on the PNAS website at the time of publication. SI is referred to in the text and cannot be altered by authors after acceptance.

SI may take the form of supplemental figures, tables, datasets, derivations, and audio and videos files.

(*xiv*) **PNAS Latest Articles.** PNAS articles are published daily. Papers may be published online 1 to 4 weeks before they appear in an issue. Authors who return proofs quickly and keep changes to a minimum get maximum publication speed. The article publication date is the official date of record and the final version of the article.

(*xv*) **Open Access.** All PNAS articles are free within 6 months of publication. Authors who choose the open access option can have their articles made available without cost to the reader immediately upon publication. Open access articles are published under a nonexclusive License to Publish and distributed under a Creative Commons Attribution-NonCommercial-NoDerivatives (CC BY-NC-ND) license or a CC BY license for authors whose funders or institutions require it.

(*xvi*) **Errata.** PNAS publishes corrections for errors, made by the journal or authors, of a scientific nature that do not alter the overall basic results or conclusions of a published article. PNAS articles may be retracted by their authors or by the editor because of pervasive error or unsubstantiated or irreproducible data. Articles may be retracted, for example, because of honest error, scientific misconduct, or plagiarism. Errata are published at the discretion of the editors and appear as formal notices in the journal. Requests to publish errata should be sent to PNAScorrections@nas.edu.

SUBMISSION PROCEDURES

Initial Submission

All authors must submit their articles at the PNAS submission site. **Only a single PDF file containing all text, figures, tables, and supporting information (SI) is required for initial submissions; high-resolution files are not required**. Manuscripts do not need to be formatted according to specific journal guidelines at this stage. The corresponding author must include the following information for each coauthor: author order, first name, last name, email, and institution. A cover letter (optional), movie files, and datasets may be uploaded separately.

A length estimate is not required, but a standard 6-page article is approximately 4,000 words, 50 references, and 4 medium-size graphical elements (i.e., figures and tables). The preferred length of articles remains at 6 pages, but PNAS will allow articles up to a maximum of 12 pages. Authors writing their papers in LaTeX should use our LaTeX template. Authors will need to complete the License to Publish online and provide permissions for any previously published material.

Manuscript Length. The preferred length of articles is 6 pages, but PNAS will allow articles up to a maximum of 12 pages. A manuscript file template for Word files is available. Authors writing their papers in LaTeX should use our LaTeX template.

An optional online submission tool estimates whether the manuscript fits within PNAS length requirements (see Length Estimate Guidelines and FAQ).

Quick reference for page proof estimates

Proof pages	Word count	Maximum no. of figures and tables*	Maximum no. of references*
6	4,000	4	50
7	4,500	5	55
8	5,000	6	60
9	5,500	7	70
10	6,000	8	75
11	6,500	9	80
12	7,000	10	85

*These estimates assume medium-size figures and tables.

Brief Reports may be up to 18,000–20,000 characters, including all text, spaces, and the number of characters displaced by equations and graphical elements. Brief Reports are limited to 2 graphical elements (e.g., figures and tables).

Revised Submission

Authors of revisions or resubmissions must provide publication-ready source files; guidelines for submitting source files appear in *Manuscript Format and Files*.

Revised papers must be received within 2 months or they will be treated as new submissions. If you require additional time, please notify PNAS. Multiple revisions are rarely permitted, and there is no guarantee that revised papers will be accepted.

Resubmission/Revision Cover Letter. The cover letter should include a point-by-point response to the comments of the reviewers and editor. A detailed description of all changes made is required before PNAS can process the revision.

Contributed Submission.

When submitting a Contributed manuscript for review, the NAS member should supply a single PDF file containing all text, figures, tables, and supporting information. High-resolution files are not required until the finished manuscript is ready to be assessed by the Editorial Board. The NAS member will act as the corresponding author during the review process.

At the completion of the review process for Contributed papers, the NAS member may designate a coauthor to serve as corresponding author and upload final submission files. At this time, authors must provide publication-ready source files; guidelines for submitting source files appear in *Manuscript Format and Files*. See Editorial and Journal Policies for further information on Contributed Submissions.

Manuscript Format and Files

When a revision is submitted to PNAS, all files must be in production-ready format; extensive edits will not be allowed at proofs. Text files should be provided in Word, RTF, or LaTeX format. Tables should be included at the end of the manuscript file. Word and RTF manuscript files should not contain any embedded figures or schemes; these should be uploaded individually in TIFF, EPS, PPT, or high-resolution PDF. Supporting Information can include datasets and movies in addition to a single SI Appendix PDF. Please see the *Supporting Information* section for details.

Please supply high-resolution files whenever possible. Resolution of at least 1200 dpi is needed for all line art, 600 dpi for images that combine line art with photographs/halftones, and 300 dpi for color or grayscale photographic images. Please review the PNAS Digital Art Guidelines. High-resolution files are not required for initial submissions.

Manuscript Order. Many authors find it useful to organize their manuscript sections as follows: title page, abstract, significance statement, introduction, results, discussion, materials and methods, acknowledgments, references, and figure legends. If authors present information clearly and concisely, other variations to this format are allowed. Number all manuscript pages starting with the title page.

Title Page. Please include the following information on the title page:

Classification: Select a major (Physical, Social, or Biological Sciences) and a minor category from the following. Dual classifications are permitted between major categories and in exceptional cases, subject to Editorial Board approval, within a major category.

PHYSICAL SCIENCES: Applied Mathematics; Applied Physical Sciences; Astronomy; Biophysics and Computational Biology;

Chemistry; Computer Sciences; Earth, Atmospheric, and Planetary Sciences; Engineering; Environmental Sciences; Mathematics; Physics; Statistics; and Sustainability Science.

SOCIAL SCIENCES: Anthropology; Economic Sciences; Environmental Sciences; Political Sciences; Psychological and Cognitive Sciences; Social Sciences; and Sustainability Science.

BIOLOGICAL SCIENCES: Agricultural Sciences; Anthropology; Applied Biological Sciences; Biochemistry; Biophysics and Computational Biology; Cell Biology; Developmental Biology; Ecology; Environmental Sciences; Evolution; Genetics; Immunology and Inflammation; Medical Sciences; Microbiology; Neuroscience; Pharmacology; Physiology; Plant Biology; Population Biology; Psychological and Cognitive Sciences; Sustainability Science; and Systems Biology.

Title: Titles should be no more than 3 typeset lines (generally 135 characters including spaces) and should be comprehensible to a broad scientific audience. The organism studied should be included.

Author Line: List the full names of all authors in the order intended for publication. Include asterisks to designate co-corresponding authors and superscripts to indicate equal contributions.

Author Affiliation: Include department, institution, and complete address, with the ZIP/postal code, for each author. Use superscripts to match authors with institutions. Multiple affiliations are allowed. Authors are strongly encouraged to supply their ORCID identifier.

Corresponding Author: The name, complete address, phone number, and email address of the author or authors to whom correspondence and proofs should be sent. Email addresses will be published in the article footnotes.

Keywords: Keywords are listed below the article abstract. At least 3 keywords are required at submission.

Abstract. Provide an abstract of no more than 250 words on page 2 of the manuscript. Abstracts should explain to the general reader the major contributions of the article. References in the abstract must be cited in full within the abstract itself and cited in the text.

Significance Statement. Authors must submit a statement of no more than 120 words about the significance of their research paper written at a level understandable to an undergraduate-educated scientist outside their field of specialty. The primary goal of the Significance Statement is to explain the relevance of the work in broad context to a broad readership. Significance statements are not required for Brief Reports.

Text. Describe procedures in sufficient detail so that the work can be repeated. Methods must be presented after results and discussion. Follow the spelling and usage given in *Webster's Third New International Dictionary* or the *Random House Dictionary of the English Language*. Avoid laboratory jargon. Correct chemical names should be given, and strains of organisms should be specified. Trade names should be identified by an initial capital letter with the remainder of the name lowercase. Names of suppliers of uncommon reagents or instruments should be provided. Use Système International units and symbols whenever possible. Statements of novelty and priority are not permitted in the text.

Language Editing Services: Prior to submission, authors who believe their manuscripts would benefit from professional editing are encouraged to use an editing service (see list here). PNAS does not take responsibility for or endorse these services, and their use has no bearing on acceptance of a manuscript for publication.

Use of URLs in Text: As a publisher, PNAS must be able to archive the data essential to a published article. Where such archiving is not possible, deposition of data in public databases, such as GenBank, ArrayExpress, Protein Data Bank, Unidata, and others outlined in the Information for Authors, is acceptable. Only links to websites that are permanent public repositories, such as self-perpetuating online resources funded by government, academia, and industry, are permitted. Links to an author's personal web page are not acceptable.

Gene Nomenclature: Prior to submission, authors should consult Genecards, MGI Nomenclature page, HUGO Gene Nomenclature Committee, or equivalent resources, to ensure standardized nomenclature is used for species-specific gene and protein names. For proposed gene names, please submit the gene symbols to the appropriate nomenclature committee as these must be deposited and approved before publication of the article.

Abbreviations: Abbreviations should be accessible to a broad scientific audience; abbreviations that are specific to a particular field should be defined at first mention in the text.

Nomenclature and Style: Use international standards on nomenclature. PNAS uses *Scientific Style and Format: The CSE Manual for Authors, Editors, and Publishers* (8th edition, 2014) as the primary style guide.

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