**Description**

*Systematic and Applied Microbiology* deals with various aspects of microbial diversity and systematics of prokaryotes. It focuses on *Bacteria* and *Archaea*; eukaryotic microorganisms will only be considered in rare cases. The journal perceives a broad understanding of microbial diversity and encourages the submission of manuscripts from the following branches of microbiology:

**Systematics**: Theoretical and practical issues dealing with classification and taxonomy, i.e. (i) new descriptions or revisions of prokaryotic taxa, including descriptions of not-yet cultured taxa in the category *Candidatus* (ii) innovative methods for the determination of taxonomical and genealogical relationships, (iii) evaluation of intra-taxon diversity through multidisciplinary approaches, (iv) identification methods.

**Applied Microbiology**: all aspects of agricultural, industrial, and food microbiology are welcome, including water and wastewater treatment.

**Comparative biochemistry and genomics**: studies concerning biochemical/metabolic and genomic diversity of cultured as well as yet-uncultured *Bacteria* and *Archaea*.

**Ecology**: polyphasic descriptions of the microbial diversity and community composition of natural and man-made ecosystems; studies quantifying the size, dynamics, and function of microbial populations; innovative research on the interaction of micro-organisms with each other and their biotic and abiotic environments. The description of candidate taxa is highly encouraged but should be based on high quality metagenomic information, as well as the in situ identification of the target bacterial or archaeal populations.

**Audience**

Bacteriologists, taxonomists, microbial ecologists, industrial, food and agricultural microbiologists

**Impact Factor**

2016: 3.931 © Clarivate Analytics Journal Citation Reports 2017
ABSTRACTING AND INDEXING

Abstracts on Hygiene and Communicable Diseases  
BioScience Information Service  
Biotechnology Citation Index  
CAB Abstracts  
Cambridge Scientific Abstracts  
Current Advances in Ecological and Environmental Sciences  
Chemical Abstracts  
Current Contents (Life Sciences, Clinical Medicine)  
Dairy Science Abstracts  
Deep-Sea Research/Part B: Oceanographic Literature Review  
Elsevier BIOBASE/Current Awareness in Biological Sciences  
EMBASE/Excerpta Medica  
FSTA (Food Science and Technology Abstracts)  
Helminthological Abstracts  
MEDLINE®  
Referativnyi Zhurnal VINTI-RAN (Russian Academy of Sciences)  
Research Alert  
Review of Applied Entomology  
Review of Medical and Veterinary Mycology  
Review of Plant Pathology  
Science Citation Index Expanded  
SCISEARCH  
Scopus  
Tropical Diseases Bulletin  
Veterinary Bulletin

EDITORIAL BOARD

Executive Editors  
Rudolf Amann, Max-Planck-Inst. (MPI) for Marine Microbiology & Jacobs University Bremen, Celsiusstrasse 1, 28359, Bremen, Germany  
Ramon Rosselló-Móra, Area de Microbiologia, Departament de Recursos Naturals, Institut Mediterrani d’Estudis Avançats (CSIC-UIB), C/Miquel Marques 21, 07190, Es porles, Illes Balears, Spain  
Karl-Heinz Schleifer, Lehrstuhl für Mikrobiologie, Technische Universität München, Emil-Ramann-Str. 4, 85354, Freising, Germany

Language Editor  
Chris Rodgers, San Carlos de la Rapita, Spain

Editorial Assistant / Living Tree Project  
Raúl Muñoz Jiménez, Institut Mediterrani d’Estudis Avançats (CSIC-UIB), Carrer de Miquel Marqués, 21, 07190, Esporles, Spain

Editors  
David Ruiz Arahal, Valencia, Spain  
Michael Blaut, Nuthetal, Germany  
Hans Jürgen Busse, Vienna, Austria  
Ralf Conrad, Marburg, Germany  
Milton Da Costa, Coimbra, Portugal  
Sofie De Meyer, Murdoch, Australia  
Matthias A. Ehrmann, Freising, Germany  
Jean Paul Euzéby, Toulouse, France  
Frank Oliver Glöckner, Bremen, Germany  
Peter Kämpfer, Giessen, Germany  
Kostas Konstantinidis, Atlanta, USA  
Milagros Léon-Barrios, La Laguna, Tenerife, Spain  
Wolfgang Liebl, Freising, Germany  
Wolfgang Ludwig, Freising, Germany  
Mari Carmen Macián, Paterna, Spain  
Esperanza Martínez Romero, Cuernavaca, Mexico  
Rainer Meckenstock, Essen, Germany
Aharon Oren, Jerusalem, Israel
Ernesto Ormeño-Orrillo, Cuernavaca, Mexico
Alvaro Peix, Salamanca, Spain
Jakob Pernthaler, Zürich, Switzerland
Jesus Romalde, Santiago de Compostela, Spain
Siegfried Scherer, Freising, Germany
Michael Schloter, München, Germany
Andreas Schramm, Aarhus, Denmark
David A. Stahl, Seattle, USA
Michael Teuber, Zurich, Switzerland
Encarna Velazquez, Salamanca, Spain
Fanus Venter, Pretoria, South Africa
En Tao Wang, Mexico City, Mexico
Friedrich Widdel, Bremen, Germany
Anne Willems, Gent, Belgium
GUIDE FOR AUTHORS

Introduction

*Systematic and Applied Microbiology* deals with various aspects of microbial diversity and systematics of prokaryotes. It focuses on *Bacteria* and *Archaea*; eukaryotic microorganisms will only be considered in rare cases. The journal perceives a broad understanding of microbial diversity and encourages the submission of manuscripts from the following branches of microbiology:

**Systematics:** Theoretical and practical issues dealing with classification and taxonomy, i.e. (i) new descriptions or revisions of prokaryotic taxa, including descriptions of not-yet cultured taxa in the category Candidatus, (ii) innovative methods for the determination of taxonomical and genealogical relationships, (iii) evaluation of intra-taxon diversity through multidisciplinary approaches, (iv) identification methods.

**Applied Microbiology:** all aspects of agricultural, industrial, and food microbiology are welcome, including water and wastewater treatment.

**Comparative biochemistry and genomics:** studies concerning biochemical/metabolic and genomic diversity of cultured as well as yet-uncultured *Bacteria* and *Archaea*.

**Ecology:** polyphasic descriptions of the microbial diversity and community composition of natural and man-made ecosystems; studies quantifying the size, dynamics, and function of microbial populations; innovative research on the interaction of micro-organisms with each other and their biotic and abiotic environments. The description of candidate taxa is highly encouraged but should be based on high quality metagenomic information, as well as the *in situ* identification of the target bacterial or archaeal populations.

**Types of paper**

Minireviews are short review papers, normally not exceeding 6 printed pages, concerned with matters of particular interest and current importance. They must be based on published articles.

Full-length papers should be as concise as possible.

Short communications should not exceed 3 printed pages, including illustrations. The paper should be preceded by a brief summary, and division of the text into various sections may be dispensed with.

**Contact details for submissions**

For questions on the submission and reviewing process, please contact leeb@mikro.biologie.tumuenchen.de. For technical questions, please use our help site at: http://epsupport.elsevier.com/. Here you will be able to learn more about the online submission and editorial system via interactive tutorials, explore a range of problem solutions via our knowledgebase, and find answers to frequently asked questions. You will also find our support contact details should you need any assistance from one of our customer service representatives.

**Page charges**

This journal has no page charges.

**Submission checklist**

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

**Ensure that the following items are present:**

One author has been designated as the corresponding author with contact details:

- E-mail address
- Full postal address

All necessary files have been uploaded:

**Manuscript:**

- Include keywords
- All figures (include relevant captions)
- All tables (including titles, description, footnotes)
- Ensure all figure and table citations in the text match the files provided
- Indicate clearly if color should be used for any figures in print

**Graphical Abstracts / Highlights files** (where applicable)

**Supplemental files** (where applicable)

Further considerations
• Manuscript has been 'spell checked' and 'grammar checked'
• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)
• A competing interests statement is provided, even if the authors have no competing interests to declare
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

BEFORE YOU BEGIN

**Ethics in publishing**
Please see our information pages on Ethics in publishing and Ethical guidelines for journal publication.

**Declaration of interest**
All authors must disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential competing interests include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors must disclose any interests in two places: 1. A summary declaration of interest statement in the title page file (if double-blind) or the manuscript file (if single-blind). If there are no interests to declare then please state this: ‘Declarations of interest: none’. This summary statement will be ultimately published if the article is accepted. 2. Detailed disclosures as part of a separate Declaration of Interest form, which forms part of the journal's official records. It is important for potential interests to be declared in both places and that the information matches. More information.

**Submission declaration and verification**
Submission of an article implies that the work described has not been published previously (except in the form of an abstract, a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. To verify originality, your article may be checked by the originality detection service Crossref Similarity Check.

**Preprints**
Please note that preprints can be shared anywhere at any time, in line with Elsevier's sharing policy. Sharing your preprints e.g. on a preprint server will not count as prior publication (see 'Multiple, redundant or concurrent publication' for more information).

**Changes to authorship**
Authors are expected to consider carefully the list and order of authors before submitting their manuscript and provide the definitive list of authors at the time of the original submission. Any addition, deletion or rearrangement of author names in the authorship list should be made only before the manuscript has been accepted and only if approved by the journal Editor. To request such a change, the Editor must receive the following from the corresponding author: (a) the reason for the change in author list and (b) written confirmation (e-mail, letter) from all authors that they agree with the addition, removal or rearrangement. In the case of addition or removal of authors, this includes confirmation from the author being added or removed. Only in exceptional circumstances will the Editor consider the addition, deletion or rearrangement of authors after the manuscript has been accepted. While the Editor considers the request, publication of the manuscript will be suspended. If the manuscript has already been published in an online issue, any requests approved by the Editor will result in a corrigendum.

**Article transfer service**
This journal is part of our Article Transfer Service. This means that if the Editor feels your article is more suitable in one of our other participating journals, then you may be asked to consider transferring the article to one of those. If you agree, your article will be transferred automatically on your behalf with no need to reformat. Please note that your article will be reviewed again by the new journal. More information.
Copyright
Upon acceptance of an article, authors will be asked to complete a 'Journal Publishing Agreement' (see more information on this). An e-mail will be sent to the corresponding author confirming receipt of the manuscript together with a 'Journal Publishing Agreement' form or a link to the online version of this agreement.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the Publisher is required for resale or distribution outside the institution and for all other derivative works, including compilations and translations. If excerpts from other copyrighted works are included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases.

For gold open access articles: Upon acceptance of an article, authors will be asked to complete an 'Exclusive License Agreement' (more information). Permitted third party reuse of gold open access articles is determined by the author's choice of user license.

Author rights
As an author you (or your employer or institution) have certain rights to reuse your work. More information.

Elsevier supports responsible sharing
Find out how you can share your research published in Elsevier journals.

Role of the funding source
You are requested to identify who provided financial support for the conduct of the research and/or preparation of the article and to briefly describe the role of the sponsor(s), if any, in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. If the funding source(s) had no such involvement then this should be stated.

Funding body agreements and policies
Elsevier has established a number of agreements with funding bodies which allow authors to comply with their funder’s open access policies. Some funding bodies will reimburse the author for the gold open access publication fee. Details of existing agreements are available online.

Open access
This journal offers authors a choice in publishing their research:

Subscription
• Articles are made available to subscribers as well as developing countries and patient groups through our universal access programs.
• No open access publication fee payable by authors.
• The Author is entitled to post the accepted manuscript in their institution's repository and make this public after an embargo period (known as green Open Access). The published journal article cannot be shared publicly, for example on ResearchGate or Academia.edu, to ensure the sustainability of peer-reviewed research in journal publications. The embargo period for this journal can be found below.

Gold open access
• Articles are freely available to both subscribers and the wider public with permitted reuse.
• A gold open access publication fee is payable by authors or on their behalf, e.g. by their research funder or institution.

Regardless of how you choose to publish your article, the journal will apply the same peer review criteria and acceptance standards.

For gold open access articles, permitted third party (re)use is defined by the following Creative Commons user licenses:
Creative Commons Attribution (CC BY)
Let others distribute and copy the article, create extracts, abstracts, and other revised versions, adaptations or derivative works of or from an article (such as a translation), include in a collective work (such as an anthology), text or data mine the article, even for commercial purposes, as long as they credit the author(s), do not represent the author as endorsing their adaptation of the article, and do not modify the article in such a way as to damage the author's honor or reputation.

Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)
For non-commercial purposes, let others distribute and copy the article, and to include in a collective work (such as an anthology), as long as they credit the author(s) and provided they do not alter or modify the article.

The gold open access publication fee for this journal is **USD 2500**, excluding taxes. Learn more about Elsevier's pricing policy: [https://www.elsevier.com/openaccesspricing](https://www.elsevier.com/openaccesspricing).

Green open access
Authors can share their research in a variety of different ways and Elsevier has a number of green open access options available. We recommend authors see our green open access page for further information. Authors can also self-archive their manuscripts immediately and enable public access from their institution's repository after an embargo period. This is the version that has been accepted for publication and which typically includes author-incorporated changes suggested during submission, peer review and in editor-author communications. Embargo period: For subscription articles, an appropriate amount of time is needed for journals to deliver value to subscribing customers before an article becomes freely available to the public. This is the embargo period and it begins from the date the article is formally published online in its final and fully citable form. Find out more.

This journal has an embargo period of 12 months.

Language (usage and editing services)
Please write your text in good English (American or British usage is accepted, but not a mixture of these). Authors who feel their English language manuscript may require editing to eliminate possible grammatical or spelling errors and to conform to correct scientific English may wish to use the English Language Editing service available from Elsevier's WebShop.

Informed consent and patient details
Studies on patients or volunteers require ethics committee approval and informed consent, which should be documented in the paper. Appropriate consents, permissions and releases must be obtained where an author wishes to include case details or other personal information or images of patients and any other individuals in an Elsevier publication. Written consents must be retained by the author but copies should not be provided to the journal. Only if specifically requested by the journal in exceptional circumstances (for example if a legal issue arises) the author must provide copies of the consents or evidence that such consents have been obtained. For more information, please review the Elsevier Policy on the Use of Images or Personal Information of Patients or other Individuals. Unless you have written permission from the patient (or, where applicable, the next of kin), the personal details of any patient included in any part of the article and in any supplementary materials (including all illustrations and videos) must be removed before submission.

Submission
Our online submission system guides you stepwise through the process of entering your article details and uploading your files. The system converts your article files to a single PDF file used in the peer-review process. Editable files (e.g., Word, LaTeX) are required to typeset your article for final publication. All correspondence, including notification of the Editor's decision and requests for revision, is sent by e-mail.

Submit your article
Please submit your article via [http://ees.elsevier.com/syapm](http://ees.elsevier.com/syapm).

Referees
Please submit the names and institutional e-mail addresses of several potential referees. For more details, visit our Support site. Note that the editor retains the sole right to decide whether or not the suggested reviewers are used.
**Guidelines for taxonomic papers**

All new taxa descriptions must be accompanied by a Digital Protologue (DP) in the form of a table and not as traditionally provided in the text. The DP must be prepared using the DP database (DPD) available from the [http://imedea.uib-csic.es/dprotologue/](http://imedea.uib-csic.es/dprotologue/) website that generates a unique Taxonumber. Authors should fill in the form obtained with the maximum quantity of information and metadata as possible. Note that this results in a Protologue, therefore, the results given in the Features section do not correspond to the type strain only, but also to the complete set of strains used for the classification of the new taxon. This will highlight the intraspecific diversity of the taxon.

Once the DP is completed, the author must submit it to the database and it can be exported subsequently either as a PDF file via the Journal Ready button or in .xls or .csv format from the main page. Alternatively, the submitter of the DP will receive the table in an email that can be formatted and then submitted to the journal as one of the manuscript submission files. However, please note that the information given for the "Date of entry", "Draft Number/Date", "Effective Publication Date", "Valid Publication Date" and "Version" should not be included in the table. The resulting table must then be sent as the Species Description Protologue. If the manuscript contains several new species or genus descriptions, a single table may be produced with as many columns as the number of taxa classified in the manuscript. Nevertheless, if the manuscript contains new genera, the genus Protologue can be given either in a unique table (preferred) or split into two tables (in the case of several genera and several species). Should the table contain citations, these must be listed in the reference section. Higher taxa Protologues must still be provided in the traditional way at the end of the manuscript.

The last sentence of the manuscript should introduce the Protologue and also specify each of the unique Taxonumbers provided in the Digital Protologue table, according to the following statement: "The formal proposal of the new genus "Genus gen. nov." and new species "Genus species sp. nov." is given in Table XX with the Taxonumbers GAXXXX and TAXXXX ".

An example of a DP table can be found [here](http://imedea.uib-csic.es/dprotologue/).

Submitted taxonomic manuscripts must fulfill the following standards:

(i) For any new species of a genus a type strain must be designated, this strain must be deposited in two culture collections in different countries and the accession numbers must be available on the date of the submission. This strain must be comprehensively studied by means of a polyphasic approach, including genetic and phenotypic traits.

(ii) The use of more than a single strain for descriptions of new genera and/or species is highly encouraged. It is of the utmost importance that all strains are equally studied in order to describe intraspecific diversity.

(iii) It is necessary to determine an Overall Genome Relatedness Index (OGRI; Chun and Rainey (2014) Int J Syst Evol Microbiol 64, 316 - 324), as it could be the average nucleotide identity (ANI) between genomes (either complete or in high coverage), as recommended in Richter and Rosselló-Móra (2009), PNAS, 106(45): 19126-19131. However, other widely used indexes especially devised to estimate genome relatedness are also accepted. The analyses must be carried out with the type strain of the species and the closest relatives of the putative new taxon. Also the closest relative type strain genome sequences must be used when the 16S rRNA gene sequence similarities lie above 97%. In exceptional cases, DNA-DNA hybridization analyses will be accepted, but in silico genome comparisons (ANId, ANIm, OrthoANI, GBDP,...) are preferred.

(iv) Any taxonomic paper should be accompanied by a fingerprint of the strain/strains used to classify a new taxon by means of methods such as ERIC-, REP-, BOX-, (GTG)5- and/or RAPD-PCR, or even whole-cell protein profiles. It is obligatory to show that the different strains in use, belonging to the same taxon, are not clonal varieties. The picture of the profiles showing the differences between isolates of the same taxon should be submitted as supplementary material if they do not provide additional information. In cases of clonality, this should be discussed in order to understand the reasons for using multiple identical clones (mainly justifiable if they have been isolated from different samples).

(v) The nearly complete 16S rRNA gene sequence (more than 1300 nucleotides) of the type strain of the species must be studied and deposited in a public repository. The accession number must be given.
(vi) The type strains of the most closely related taxa must be simultaneously investigated. It is of the utmost importance that all reference strains are tested with the same methods as the strains of the new taxon. Submissions where the discriminative tests of the reference strains are simply taken from the literature will not be reviewed, unless they are based on results obtained with the same methods. If possible, phenotypic tests should be performed by means of standardized methods.

(vii) It is highly recommended that chemotaxonomic markers are studied, especially if these have been used as diagnostic features for the genus harboring the new taxon. It will be compulsory to show the chemical composition peculiarities for new general descriptions. Recommended markers are fatty acid profiles, polar lipid composition, quinone types, polyamine patterns, and peptidoglycan type/composition (in particular for the description of Gram-positive bacteria, but also considering that Gram-negative bacteria may differ in their diamino acid composition).

(viii) It is compulsory to give the G+C mole % values of the genome of the type strain of the type species of a new genus.

(ix) For non-ribosomal gene sequence analyses (e.g. MLSA), all accession numbers of the generated sequences must be given. In addition, it is compulsory to submit the full alignments used to generate the trees that are to be published. The alignments will be published as online supplementary material.

(x) For any new taxon, the etymology of the proposed name must be provided.

(xi) For any new taxon, a protologue indicating the discriminative traits that are characteristic of the taxon should be clearly given. One should avoid linking tables to the protologue. The text should contain all the necessary information that explains how the taxon can be identified.

(xii) The discriminative phenotype should be summarized in a diagnostic table where the most closely related taxa are also indicated.

(xiii) Each description must be accompanied at the end of the manuscript by the protologue written in accordance with the Bacteriological Code requirements.

*Single strain descriptions.* Single strain taxa descriptions (SSSD) are accepted only in exceptional cases. Exceptionalness may result from the relevance of the strain and of the work that has been done with it independently whether it has been published elsewhere. Cases such as full genome sequencing, ecological relevance in their environment, being a result of the isolation of a "candidatus" organism, or very especial metabolisms may be regarded as being of additional interest. Also, if the taxonomic work is done exhaustively and properly, adding new approaches, e.g. MLSA, ANI calculations, completing the phenotypic analyses by means of several chemotaxonomic markers and exhaustive metabolic studies, and any additional information that balances the lack of additional cultures (e.g. phage susceptibility, metabolic properties that are of biotechnological or industrial importance) would also be regarded as exceptionalness. Should this be the case, the authors must send a cover letter to the editor explaining why this new species deserves to be published in the journal, clarifying the uniqueness of the findings and the exceptionality of the new isolate. Manuscripts not fulfilling the length and the exceptionality requirements will be directly rejected. Note, that SAM encourages compiling several SSSDs in a single manuscript when no additional strains had been isolated for each distinct species.

*Candidatus* taxa descriptions. SAM encourages the submission of new candidate taxa. The Candidatus category is be "used for describing prokaryotic entities for which more than a mere sequence is available but for which characteristics required for description according to the International Code of Nomenclature of Bacteria are lacking. In addition to genomic information, such as sequences apt to determine the phylogenetic position of the organism, all information, including structural, metabolic, and reproductive features, should be included in the description of a provisional taxon, together with the natural environment in which the organism can be identified by in situ hybridization or other similar techniques for cell identification" (Murray and Stackebrandt (1995), Int. J. Syst. Bacteriol., 45:186-187). In general, such descriptions have been made for organisms
with conspicuous characteristics related to their morphology, lifestyle or ultrastructure. However, high quality metagenome sequencing allows binning genomes of inconspicuous single prokaryotic populations whose formal description may be relevant for the scientific community.

SAM encourages the submission of proposals of candidate taxa based on high quality metagenome bins, which meet the minimal standards necessary to ensure their unequivocal identification (for recommendations see: Konstantinidis and Rosselló-Móra (2015), Syst. Appl. Microbiol., 38:223-230). All Candidatus descriptions should meet the premises established in the Bacteriological Code, and must be accompanied by the 16S rRNA gene sequence, the in situ identification of the target bacterial or archaeal populations, and the deposit of a high quality binned metagenomic sequence.

PREPARATION

Peer review
This journal operates a single blind review process. All contributions will be initially assessed by the editor for suitability for the journal. Papers deemed suitable are then typically sent to a minimum of two independent expert reviewers to assess the scientific quality of the paper. The Editor is responsible for the final decision regarding acceptance or rejection of articles. The Editor's decision is final. More information on types of peer review.

Use of word processing software
It is important that the file be saved in the native format of the word processor used. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork.

To avoid unnecessary errors you are strongly advised to use the 'spell-check' and 'grammar-check' functions of your word processor.

Article structure

Subdivision - unnumbered sections
Divide your article into clearly defined sections. Each subsection is given a brief heading. Each heading should appear on its own separate line. Subsections should be used as much as possible when cross-referencing text: refer to the subsection by heading as opposed to simply 'the text'.

Introduction
State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Material and methods
Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

Results
Results should be clear and concise.

Discussion
This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.

Conclusions
The main conclusions of the study may be presented in a short Conclusions section, which may stand alone or form a subsection of a Discussion or Results and Discussion section.

Appendices
If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.
**Essential title page information**

- **Title.** Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible.
- **Author names and affiliations.** Please clearly indicate the given name(s) and family name(s) of each author and check that all names are accurately spelled. You can add your name between parentheses in your own script behind the English transliteration. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lowercase superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name and, if available, the e-mail address of each author.
- **Corresponding author.** Clearly indicate who will handle correspondence at all stages of refereeing and publication, also post-publication. This responsibility includes answering any future queries about Methodology and Materials. **Ensure that the e-mail address is given and that contact details are kept up to date by the corresponding author.**
- **Present/permanent address.** If an author has moved since the work described in the article was done, or was visiting at the time, a 'Present address' (or 'Permanent address') may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

**Abstract**

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

**Graphical abstract**

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site.

Authors can make use of Elsevier's Illustration Services to ensure the best presentation of their images and in accordance with all technical requirements.

**Highlights**

Highlights are a short collection of bullet points that convey the core findings of the article. Highlights are optional and should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). You can view example Highlights on our information site.

**Keywords**

Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

**Abbreviations**

Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

**Acknowledgements**

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

**Formatting of funding sources**

List funding sources in this standard way to facilitate compliance to funder's requirements:
Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university, college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Units
Follow internationally accepted rules and conventions: use the international system of units (SI). If other units are mentioned, please give their equivalent in SI.

Nucleotide sequence data
New nucleotide data must be submitted and deposited in the DDBJ/EMBL/GenBank databases and an accession number obtained at the time of submission. Submission to any one of the three collaborating databanks is sufficient to ensure data entry in all. The accession number should be included in the manuscript e.g. as a footnote on the title page. For the evaluation of manuscripts containing gene sequences, sequence data have to be made available to the referees.

Math formulae
Please submit math equations as editable text and not as images. Present simple formulae in line with normal text where possible and use the solidus (/) instead of a horizontal line for small fractional terms, e.g., X/Y. In principle, variables are to be presented in italics. Powers of e are often more conveniently denoted by exp. Number consecutively any equations that have to be displayed separately from the text (if referred to explicitly in the text).

Footnotes
Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors can build footnotes into the text, and this feature may be used. Otherwise, please indicate the position of footnotes in the text and list the footnotes themselves separately at the end of the article. Do not include footnotes in the Reference list.

Artwork
Electronic artwork
General points
• Make sure you use uniform lettering and sizing of your original artwork.
• Embed the used fonts if the application provides that option.
• Aim to use the following fonts in your illustrations: Arial, Courier, Times New Roman, Symbol, or use fonts that look similar.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Provide captions to illustrations separately.
• Size the illustrations close to the desired dimensions of the published version.
• Submit each illustration as a separate file.
A detailed guide on electronic artwork is available.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats
If your electronic artwork is created in a Microsoft Office application (Word, PowerPoint, Excel) then please supply 'as is' in the native document format.
Regardless of the application used other than Microsoft Office, when your electronic artwork is finalized, please 'Save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):
EPS (or PDF): Vector drawings, embed all used fonts.
TIFF (or JPEG): Color or grayscale photographs (halftones), keep to a minimum of 300 dpi.
TIFF (or JPEG): Bitmapped (pure black & white pixels) line drawings, keep to a minimum of 1000 dpi.
TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale), keep to a minimum of 500 dpi.

Please do not:
• Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); these typically have a low number of pixels and limited set of colors;
• Supply files that are too low in resolution;
• Submit graphics that are disproportionately large for the content.

Color artwork
Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article. Please indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Illustration services
Elsevier's WebShop offers Illustration Services to authors preparing to submit a manuscript but concerned about the quality of the images accompanying their article. Elsevier's expert illustrators can produce scientific, technical and medical-style images, as well as a full range of charts, tables and graphs. Image 'polishing' is also available, where our illustrators take your image(s) and improve them to a professional standard. Please visit the website to find out more.

Figure captions
Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (not on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables
Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

References
Citation in text
Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Reference links
Increased discoverability of research and high quality peer review are ensured by online links to the sources cited. In order to allow us to create links to abstracting and indexing services, such as Scopus, CrossRef and PubMed, please ensure that data provided in the references are correct. Please note that incorrect surnames, journal/book titles, publication year and pagination may prevent link creation. When copying references, please be careful as they may already contain errors. Use of the DOI is encouraged.

A DOI can be used to cite and link to electronic articles where an article is in-press and full citation details are not yet known, but the article is available online. A DOI is guaranteed never to change, so you can use it as a permanent link to any electronic article. An example of a citation using DOI for an article not yet in an issue is: VanDecar J.C., Russo R.M., James D.E., Ambeh W.B., Franke M. (2003). Aseismic continuation of the Lesser Antilles slab beneath northeastern Venezuela. Journal of Geophysical Research, https://doi.org/10.1029/2001JB000884. Please note the format of such citations should be in the same style as all other references in the paper.
Web references
As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references
This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue
Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference style

References in the text should be:
- ...was discussed [6, 2]
- Ventosa et al. [10] described

Reference to literature: The List of References should appear in alphabetical order, numbered consecutively with Arabic numbers.

Formats for citations:

Journal abbreviations source
Journal names should be abbreviated according to the List of Title Word Abbreviations.

Video
Elsevier accepts video material and animation sequences to support and enhance your scientific research. Authors who have video or animation files that they wish to submit with their article are strongly encouraged to include links to these within the body of the article. This can be done in the same way as a figure or table by referring to the video or animation content and noting in the body text where it should be placed. All submitted files should be properly labeled so that they directly relate to the video file's content. In order to ensure that your video or animation material is directly usable, please provide the file in one of our recommended file formats with a preferred maximum size of 150 MB per file, 1 GB in total. Video and animation files supplied will be published online in the electronic version of your article in Elsevier Web products, including ScienceDirect. Please supply 'stills' with your files: you can choose any frame from the video or animation or make a separate image. These will be used instead of standard icons and will personalize the link to your video data. For more detailed instructions please visit our video instruction pages. Note: since video and animation cannot be embedded in the print version of the journal, please provide text for both the electronic and the print version for the portions of the article that refer to this content.

Data visualization
Include interactive data visualizations in your publication and let your readers interact and engage more closely with your research. Follow the instructions here to find out about available data visualization options and how to include them with your article.

Supplementary material
Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to
supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

**Research data**

This journal encourages and enables you to share data that supports your research publication where appropriate, and enables you to interlink the data with your published articles. Research data refers to the results of observations or experimentation that validate research findings. To facilitate reproducibility and data reuse, this journal also encourages you to share your software, code, models, algorithms, protocols, methods and other useful materials related to the project.

Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

**Data linking**

If you have made your research data available in a data repository, you can link your article directly to the dataset. Elsevier collaborates with a number of repositories to link articles on ScienceDirect with relevant repositories, giving readers access to underlying data that gives them a better understanding of the research described.

There are different ways to link your datasets to your article. When available, you can directly link your dataset to your article by providing the relevant information in the submission system. For more information, visit the database linking page.

For supported data repositories a repository banner will automatically appear next to your published article on ScienceDirect.

In addition, you can link to relevant data or entities through identifiers within the text of your manuscript, using the following format: Database: xxxx (e.g., TAIR: AT1G01020; CCDC: 734053; PDB: 1XFN).

**Mendeley Data**

This journal supports Mendeley Data, enabling you to deposit any research data (including raw and processed data, video, code, software, algorithms, protocols, and methods) associated with your manuscript in a free-to-use, open access repository. Before submitting your article, you can deposit the relevant datasets to Mendeley Data. Please include the DOI of the deposited dataset(s) in your main manuscript file. The datasets will be listed and directly accessible to readers next to your published article online.

For more information, visit the Mendeley Data for journals page.

**Data statement**

To foster transparency, we encourage you to state the availability of your data in your submission. This may be a requirement of your funding body or institution. If your data is unavailable to access or unsuitable to post, you will have the opportunity to indicate why during the submission process, for example by stating that the research data is confidential. The statement will appear with your published article on ScienceDirect. For more information, visit the Data Statement page.

**AFTER ACCEPTANCE**

**Online proof correction**

Corresponding authors will receive an e-mail with a link to our online proofing system, allowing annotation and correction of proofs online. The environment is similar to MS Word: in addition to editing text, you can also comment on figures/tables and answer questions from the Copy Editor. Web-based proofing provides a faster and less error-prone process by allowing you to directly type your corrections, eliminating the potential introduction of errors.

If preferred, you can still choose to annotate and upload your edits on the PDF version. All instructions for proofing will be given in the e-mail we send to authors, including alternative methods to the online version and PDF.
We will do everything possible to get your article published quickly and accurately. Please use this proof only for checking the typesetting, editing, completeness and correctness of the text, tables and figures. Significant changes to the article as accepted for publication will only be considered at this stage with permission from the Editor. It is important to ensure that all corrections are sent back to us in one communication. Please check carefully before replying, as inclusion of any subsequent corrections cannot be guaranteed. Proofreading is solely your responsibility.

**Offprints**
The corresponding author will, at no cost, receive a customized Share Link providing 50 days free access to the final published version of the article on ScienceDirect. The Share Link can be used for sharing the article via any communication channel, including email and social media. For an extra charge, paper offprints can be ordered via the offprint order form which is sent once the article is accepted for publication. Both corresponding and co-authors may order offprints at any time via Elsevier’s Webshop. Corresponding authors who have published their article gold open access do not receive a Share Link as their final published version of the article is available open access on ScienceDirect and can be shared through the article DOI link.

**AUTHOR INQUIRIES**
Visit the Elsevier Support Center to find the answers you need. Here you will find everything from Frequently Asked Questions to ways to get in touch.
You can also check the status of your submitted article or find out when your accepted article will be published.