DESCRIPTION

*Biomaterials* is an international journal covering the science and clinical application of *biomaterials*. A biomaterial is now defined as a substance that has been engineered to take a form which, alone or as part of a complex system, is used to direct, by control of interactions with components of living systems, the course of any therapeutic or diagnostic procedure. It is the aim of the journal to provide a peer-reviewed forum for the publication of original papers and authoritative review and opinion papers dealing with the most important issues facing the use of biomaterials in clinical practice. The scope of the journal covers the wide range of physical, biological and chemical sciences that underpin the design of biomaterials and the clinical disciplines in which they are used. These sciences include polymer synthesis and characterization, drug and gene vector design, the biology of the host response, immunology and toxicology and self assembly at the nanoscale. Clinical applications include the therapies of medical technology and regenerative medicine in all clinical disciplines, and diagnostic systems that reply on innovative contrast and sensing agents. The journal is relevant to areas such as cancer diagnosis and therapy, implantable devices, drug delivery systems, gene vectors, bionanotechnology and tissue engineering.

Click here for New Editorial Instructions.

Benefits to authors

We also provide many author benefits, such as free PDFs, a liberal copyright policy, special discounts on Elsevier publications and much more. Please click here for more information on our author services.

Please see our Guide for Authors for information on article submission. If you require any further information or help, please visit our Support Center

*Biomaterials* is the flagship title in Elsevier's biomaterials science portfolio; it sits alongside *Materials Today Bio*, *Materials Science and Engineering C: Materials for Biological Applications* and *Biomaterials and Biosystems*. As part of the broader Materials Today family, *Biomaterials* offers authors rigorous peer review, rapid decisions, and high visibility. We look forward to receiving your submissions!

AUDIENCE

Biomaterials scientists, materials scientists, clinicians (vascular surgeons, orthopaedic surgeons, dentists), biomedical engineers, biochemists, pharmaceutical scientists, tissue engineers and medical device technologists.
IMPACT FACTOR

2018: 10.273 © Clarivate Analytics Journal Citation Reports 2019

ABSTRACTING AND INDEXING

BECI
INSPEC
CTI
Biomaterials Now and Current Titles in Dentistry
PubMed/Medline
Current Contents
Embase
Elsevier BIOBASE
Polymer Contents
BIOSIS Citation Index
Chemical Abstracts
ADONIS
Science Citation Index
FIZ Karlsruhe
Scopus

EDITORIAL BOARD

Editor-in-Chief
Kam Leong, Columbia University Department of Biomedical Engineering, United States
Biodegradable drug carriers/polymers; Non-viral gene delivery and Immunotherapy; Drug Delivery; Tissue Engineering scaffolds

Managing Editor
Chai Hoon Quek

Associate Editors
Youngro Byun, Seoul National University Department of Molecular Medicine and Biopharmaceutical Science, The Republic of Korea
Barbara Chan, University of Hong Kong, Hong Kong
Chong-Su Cho, Seoul National University, The Republic of Korea
Andres Garcia, Georgia Institute of Technology, United States
Stuart B. Goodman, Stanford University Department of Orthopaedic Surgery, United States
Xing-Jie Liang, National Center for Nanoscience and Technology, China
Zhuang Liu, Soochow University, China
Hai-Quan Mao, Johns Hopkins University, United States
Yukio Nagasaki, University of Tsukuba, Japan
Abhay Pandit, National University of Ireland Galway, Ireland
Ana Paula Pêgo, University of Porto, Portugal
Laura Anne Poole-Warren, University of New South Wales, Australia
Hsing-Wen Sung, National Tsing Hua University, Taiwan
Jun Wang, South China University of Technology, China
Hanry Yu, National University of Singapore, Singapore
WeChat/Weibo Manager
Mingqiang Li, Sun Yat-Sen University, China

Honorary Editor
David Williams, Wake Forest University School of Medicine, United States
One Sheffield Place, Winston-Salem, North Carolina, 27104, USA Professor and Director of International Affairs, Wake Forest Institute of Regenerative Medicine, North Carolina, USA Visiting Professor, Christiana Barnard Department of Cardiothoracic Surgery, Cape Town, South Africa Visiting Professorial Fellow, Graduate School of Biomedical Engineering, University of New South Wales, Sydney, Australia Guest Professor, Tsinghua University, Beijing, and Visiting Professor Shanghai Jiao Tong University, China Emeritus Professor, University of Liverpool, UK
International Editorial Board

Hua Ai, Sichuan University, China
Luigi Ambrosio, University of Naples Federico II, Italy
James Anderson, Case Western Reserve University, United States
Carla Renata Arciola, Research Hospital Rizzoli Orthopedic Institute, Italy

Microbiology

Stephen Francis Badylak, University of Pittsburgh, United States
Thomas Barker, University of Virginia, United States
Susan Bellis, University of Alabama at Birmingham, United States
Davide Campoccia, Research Hospital Rizzoli Orthopedic Institute, Italy

Regenerative Medicine

Rebecca Carrier, Northeastern University, United States
Jiang Chang, Shanghai Institute of Ceramics Chinese Academy of Sciences, China
George Guo-Qiang Chen, Tsinghua University, China

Plasma science and engineering; Surface engineering of functional materials; Biomaterials and nanobiology; Energy and sensor materials; Nanostructured thin films and interfaces

Simon Cool, Agency for Science Technology and Research, Singapore

J. Dai, Chinese Academy of Sciences, China

Materials Science and Bioactivity

Margaret (Meg) Evans, Commonwealth Scientific and Industrial Research Organisation, Australia

Nanotechnology and Nanomedicine

Shaoqin (Sarah) Gong, University of Wisconsin Madison, United States

Shaoqin (Sarah) Gong, University of Wisconsin Madison, United States

David Grainger, The University of Utah, United States
http://www.bioen.utah.edu/directory/profile.php?userID=295

Dirk W. Grijpma, University of Twente, Netherlands

Vasif Hasirci, Middle East Technical University Department of Biological Sciences, Turkey

Wim Hennink, Utrecht University Department of Pharmaceutical Sciences, Netherlands

Shan-Hui Hsu, National Taiwan University, Taiwan

John Hunt, Nottingham Trent University, United Kingdom

Johns research focuses on developing breakthrough therapies, devices and technology to repair, replace, augment and in the future regenerate diseased, infected and damaged tissues in humans and other mammals using material interventions. Understanding the generic science to deliver interventional medical therapies requiring the use of a material (living cells are also considered to be a material). These will come from an in depth generic first principles approach to understanding and directing the patients cellular and molecular mechanisms and responses related to the clinical outcome and efficacy of medical devices, biocompatibility, inflammation and stem cell biology. Tissue engineering processes are developed and applied, addressing the key areas of patient treatments requiring intervention and material implantation; the materials of choice being researched today also include cells and within that, expertise and intellectual property has been created relating to primary cell sourcing, controlling cell function and phenotype through defining and controlling extracellular matrix interactions, angiogenesis, inflammation and tissue regeneration. From a strong long lived generic research platform, specific applications and knowledge has been applied to and continue to be developed for musculoskeletal tissues specifically cartilage and bone, visceral and vascular tissues. Professor Hunts research has been funded by the European Commission, BBSRC, MRC and EPSRC as well as by Industry. Ph.D in 1992 and D.Sc. in 2006. He is a full time Professor and research Theme Leader at Nottingham Trent University, leading the theme Medical Technologies and Advanced Materials. He is a Fellow of the Royal Society of Chemistry and the Vice Chairperson of the committee for the specialist interest group Analytical Biosciences. He is a Fellow of the International College of Fellows for Biomaterials Science and Engineering and elected committee member and the treasurer of the colleg

Dietmar Hutmacher, Queensland University of Technology, Australia

Kazuhiko Ishihara, The University of Tokyo, Japan

Hiroo Iwata, Kyoto University, Japan

Wilhelmus de Jong, National Institute for Public Health and the Environment, Netherlands

David Kaplan, Tufts University, United States

Kazunori Kataoka, The University of Tokyo, Japan
Polymeric therapeutics, Polymeric micelles, Block copolymers, Gene delivery, Targeting, Hydrogel, Nanoparticle
Hae-Won Kim, Dankook University, The Republic of Korea
Yong-Hee Kim, Hanyang University, The Republic of Korea
C.J. Kirkpatrick, Johannes Gutenberg University, Germany
Jonathan Knowles, University College London, United Kingdom
Hyun-Joon Kong, University of Illinois at Urbana-Champaign, United States
Jindrich Henry Kopecek, The University of Utah, United States
bioconjugate chem, biodegradability of polymers, biocompatibility. Also, Biorecognition of Macromolecules and Genetically engineered biomaterials. Drug delivery systems
Subhas Chandra Kundu, Indian Institute of Technology Kharagpur, India
Damien Lacroix, The University of Sheffield, United Kingdom
Cato Laurencin, UConn Health, United States
Regenerative Engineering, Stem Cell Niche, Limb Regeneration
Doo Sung Lee, Sungkyunkwan University, The Republic of Korea
R.J. Levy, The Children's Hospital of Philadelphia, United States
Yan Li, Wuhan University, China
Feng-Huei Lin, National Taiwan University, Taiwan
Wei Liu, Shanghai Jiao Tong University - Fahua Campus, China
Ivan Martin, university Hospital Basel, Switzerland
Teruo Okano, Tokyo Women's Medical University Institute of Advanced Biomedical Engineering and Science, Japan
Tissue Engineering Polymers
Richard O.C. Oreffo, University of Southampton Institute of Developmental Science, United Kingdom
Areas of expertise: skeletal stem cells, bone regeneration, biomaterials, osteoarthritis, translation
Hong-wei Ouyang, Zhejiang University Center for Stem Cell and Regenerative Medicine, China
Buddy Ratner, University of Washington Department of Bioengineering, United States
Biomaterials and macrophage response
Rui L. Reis, University of Minho, Portugal
Ugo Ripamonti, University of the Witwatersrand, South Africa
Mark W. Saltzman, Yale University, United States
Dror Seliktar, Technion Israel Institute of Technology, Israel
Carl G. Simon, Jr., National Institute of Standards and Technology, United States
Michael Sittigten, Charite University Hospital Berlin, Germany
Tissue Engineering of Cartilage, Bone, Biomaterials and Mesenchymal Stem and Precursor Cells
Molly Stevens, Imperial College London, United Kingdom
Melody A. Swartz, University of Chicago, United States
Vladimir Trajkovic, University of Belgrade, Serbia
Rocky S. Tuan, University of Pittsburgh, United States
Hasan Uludag, University of Alberta, Canada
Robert Vernon, Benaroya Research Institute at Virginia Mason, United States
Erwin Vogler, Pennsylvania State University, United States
William Walsh, University of New South Wales, Australia
Shenguo Wang, Chinese Academy of Sciences, China
Polymer Science
Anthony S. Weiss, The University of Sydney, Australia
Areas of expertise: dermal biochemistry, technology translation, human elastic tissue assembly, damage and repair, elastic tissue engineering
Carsten Werner, TU Dresden, Germany
Masayuki Yamato, Tokyo Women's Medical University Institute of Advanced Biomedical Engineering and Science, Japan
Hyuk-Sang Yoo, Kangwon National University, The Republic of Korea
Nicholas Ziats, Case Western Reserve University School of Medicine, United States
Peter Zilla, University of Cape Town, South Africa
Cardiovascular
GUIDE FOR AUTHORS

Your Paper Your Way
We now differentiate between the requirements for new and revised submissions. You may choose to submit your manuscript as a single Word or PDF file to be used in the refereeing process. Only when your paper is at the revision stage, will you be requested to put your paper in to a 'correct format' for acceptance and provide the items required for the publication of your article.

To find out more, please visit the Preparation section below.

INTRODUCTION

Types of article
Original Research: Provide a full length account of original research.
Review: Provide an in-depth and up to date critical review of a related topic.
Leading Opinion Paper: This article type may only be submitted by invitation from the Editor-in-Chief.

Contact details for submission
The peer review submission system for Biomaterials is located here: http://ees.elsevier.com/biomat/
The Elsevier Editorial System (EES) is a web-based submission and review system. Authors may submit manuscripts and track their progress through the system to publication. Reviewers can download manuscripts and submit their opinions to the editor. Editors can manage the whole submission/review/revise/publish process.
Referees, whose names are not normally disclosed to the authors, will study all contributions which the Editor-in-Chief deems to be of sufficient significance and interest to be sent for peer review. The criteria by which this initial assessment is made include relevance to the scope of the journal, the originality of the work and its significance to the broad development of the field of biomaterials. Please note that the editorial team are not able to provide a pre-evaluation for a new submission or proposal. All submissions should be sent to the journal directly through the EES submission site. We are unable to respond to pre-evaluation requests from authors.

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.

Studies in humans and animals
If the work involves the use of human subjects, the author should ensure that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. The manuscript should be in line with the Recommendations for the Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals and aim for the inclusion of representative human populations (sex, age and ethnicity) as per those recommendations. The terms sex and gender should be used correctly.

Authors should include a statement in the manuscript that informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed.

All animal experiments should comply with the ARRIVE guidelines and should be carried out in accordance with the U.K. Animals (Scientific Procedures) Act, 1986 and associated guidelines, EU Directive 2010/63/EU for animal experiments, or the National Institutes of Health guide for the care and use of Laboratory animals (NIH Publications No. 8023, revised 1978) and the authors should clearly indicate in the manuscript that such guidelines have been followed. The sex of animals must be indicated, and where appropriate, the influence (or association) of sex on the results of the study.

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 conflicts of interest include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. Authors should complete the declaration of interest statement using this template and upload to the submission system at the Attach/Upload Files step. If there are no interests to declare, please choose: 'Declarations of interest: none' in the template. This statement will be published within the article if accepted. 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, see 'Multiple, redundant or concurrent publication' for more information), 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).

Use of inclusive language
Inclusive language acknowledges diversity, conveys respect to all people, is sensitive to differences, and promotes equal opportunities. Articles should make no assumptions about the beliefs or commitments of any reader, should contain nothing which might imply that one individual is superior to another on the grounds of race, sex, culture or any other characteristic, and should use inclusive language throughout. Authors should ensure that writing is free from bias, for instance by using 'he or she', 'his/her' instead of 'he' or 'his', and by making use of job titles that are free of stereotyping (e.g. 'chairperson' instead of 'chairman' and 'flight attendant' instead of 'stewardess').

Author contributions
For transparency, we encourage authors to submit an author statement file outlining their individual contributions to the paper using the relevant CRediT roles: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing. Authorship statements should be formatted with the names of authors first and CRediT role(s) following. More details and an example
Mandatory Author Declaration
When uploading the manuscript, it is required that the corresponding author of each manuscript 
confirms on behalf of all authors that their submission complies in full with the Author Declaration. 
Please note that the form itself doesn't have to be uploaded as part of the manuscript files.

This Declaration covers a number of logistic and ethical issues. The editorial process will not begin 
until and unless the corresponding author has answered the appropriate question during submission.

N.B.: The Author Declaration is independent of, and in addition to, the "Journal Publishing Agreement" 
agreement which is issued on acceptance.

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.
Open access
Please visit our Open Access page for more information.

Elsevier Researcher Academy
Researcher Academy is a free e-learning platform designed to support early and mid-career researchers throughout their research journey. The "Learn" environment at Researcher Academy offers several interactive modules, webinars, downloadable guides and resources to guide you through the process of writing for research and going through peer review. Feel free to use these free resources to improve your submission and navigate the publication process with ease.

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 Author Services.

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, which is used in the peer-review process. As part of the Your Paper Your Way service, you may choose to submit your manuscript as a single file to be used in the refereeing process. This can be a PDF file or a Word document, in any format or layout that can be used by referees to evaluate your manuscript. It should contain high enough quality figures for refereeing. If you prefer to do so, you may still provide all or some of the source files at the initial submission. Please note that individual figure files larger than 10 MB must be uploaded separately.

Editorial team would not do a Pre-evaluation for any new submission/proposal. Submit the papers only through EES. There will not be any response to pre-evaluation requests from the authors.

References
There are no strict requirements on reference formatting at submission. References can be in any style or format as long as the style is consistent. Where applicable, author(s) name(s), journal title/book title, chapter title/article title, year of publication, volume number/book chapter and the article number or pagination must be present. Use of DOI is highly encouraged. The reference style used by the journal will be applied to the accepted article by Elsevier at the proof stage. Note that missing data will be highlighted at proof stage for the author to correct.
**Formatting requirements**
There are no strict formatting requirements but all manuscripts must contain the essential elements needed to convey your manuscript, for example Abstract, Keywords, Introduction, Materials and Methods, Results, Conclusions, Artwork and Tables with Captions.

If your article includes any Videos and/or other Supplementary material, this should be included in your initial submission for peer review purposes.

Divide the article into clearly defined sections.

**Figures and tables embedded in text**
Please ensure the figures and the tables included in the single file are placed next to the relevant text in the manuscript, rather than at the bottom or the top of the file. The corresponding caption should be placed directly below the figure or table.

**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.

**REVISED SUBMISSIONS**

**Use of word processing software**
Regardless of the file format of the original submission, at revision you must provide us with an editable file of the entire article. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). 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**
Follow this order when typing manuscripts: Title, Authors, Affiliations, Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Conclusions, Acknowledgements, References, Appendix (where necessary), Figures, Figure Captions and Tables, Supplementary Data. The corresponding author should be identified with an asterisk and footnote including fax number and e-mail address. An abbreviated title for use as a running headline should also be supplied. Authors are requested to acknowledge funding sources for the work.

**Highlights**
Highlights are optional yet highly encouraged for this journal, as they increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Please have a look at the examples here: example Highlights.

Highlights 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).

**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 separate from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, they must be cited in full, without reference to the reference list. Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

All manuscripts are to be supplied with an abstract of about 100-200 words in length.

**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.

**Keywords**
Authors must provide 4-6 keywords for indexing purposes.

**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**
The SI system should be used for all scientific and laboratory data; if, in certain instances, it is necessary to quote other units, these should be added in parentheses. Temperatures should be given in degrees Celsius. The unit ‘billion’ (109 in America, 1012 in Europe) is ambiguous and must not be used. If a large number of symbols are used it is helpful if authors submit a list of these symbols and their meanings.

**Footnotes**
Footnotes should be used sparingly. Number them consecutively throughout the article. Many wordprocessors build footnotes into the text, and this feature may be used. Should this not be the case, indicate the position of footnotes in the text and present the footnotes themselves separately at the end of the article. Do not include footnotes in the Reference list. Footnotes on the first page thanking or acknowledging people or places should be moved to the Acknowledgements section.

**Image manipulation**
Whilst it is accepted that authors sometimes need to manipulate images for clarity, manipulation for purposes of deception or fraud will be seen as scientific ethical abuse and will be dealt with accordingly. For graphical images, this journal is applying the following policy: no specific feature within an image may be enhanced, obscured, moved, removed, or introduced. Adjustments of brightness, contrast, or color balance are acceptable if and as long as they do not obscure or eliminate any information present in the original. Nonlinear adjustments (e.g. changes to gamma settings) must be disclosed in the figure legend.

**Electronic artwork**
**General points**
• Make sure you use uniform lettering and sizing of your original artwork.
• Preferred fonts: Arial (or Helvetica), Times New Roman (or Times), Symbol, Courier.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Indicate per figure if it is a single, 1.5 or 2-column fitting image.
• For Word submissions only, you may still provide figures and their captions, and tables within a single file at the revision stage.
• Please note that individual figure files larger than 10 MB must be provided in separate source files.

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**
Regardless of the application used, 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 the font or save the text as 'graphics'.

TIFF (or JPEG): Color or grayscale photographs (halftones): always use a minimum of 300 dpi.

TIFF (or JPEG): Bitmapped line drawings: use a minimum of 1000 dpi.

TIFF (or JPEG): Combinations bitmapped line/halftone (color or grayscale): a minimum of 500 dpi is required.

Please do not:
- Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); the resolution is too low.
- 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.

Figures
Authors should aim to include not more than 8 figures in their manuscript.

Figure captions
Ensure that each illustration has a caption. 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.

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.

Web References
References to online sources should contain at a minimum the full URL and year the source was accessed. Furthermore, if known, the following information should be given: author names, dates, reference to a source publication. 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.

Examples of formatting of online sources follow:


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.

Reference style
Text: Indicate references by number(s) in square brackets in line with the text. The actual authors can be referred to, but the reference number(s) must always be given.
Example: '..... as demonstrated [3,6]. Barnaby and Jones [8] obtained a different result ....'
List: Number the references (numbers in square brackets) in the list in the order in which they appear in the text.
Examples:
Reference to a journal publication:
Reference to a journal publication with an article number:
Reference to a book:
Reference to a chapter in an edited book:
Reference to a website:
Reference to a dataset:

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. During the submission process, after uploading your manuscript, you will have the opportunity to upload your relevant datasets directly to Mendeley Data. 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 in Brief**

You have the option of converting any or all parts of your supplementary or additional raw data into one or multiple data articles, a new kind of article that houses and describes your data. Data articles ensure that your data is actively reviewed, curated, formatted, indexed, given a DOI and publicly available to all upon publication. You are encouraged to submit your article for Data in Brief as an additional item directly alongside the revised version of your manuscript. If your research article is accepted, your data article will automatically be transferred over to Data in Brief where it will be editorially reviewed and published in the open access data journal, Data in Brief. Please note an open access fee of 600 USD is payable for publication in Data in Brief. Full details can be found on the Data in Brief website. Please use this template to write your Data in Brief.

**MethodsX**

You have the option of converting relevant protocols and methods into one or multiple MethodsX articles, a new kind of article that describes the details of customized research methods. Many researchers spend a significant amount of time on developing methods to fit their specific needs or setting, but often without getting credit for this part of their work. MethodsX, an open access journal, now publishes this information in order to make it searchable, peer reviewed, citable and reproducible. Authors are encouraged to submit their MethodsX article as an additional item directly alongside the revised version of their manuscript. If your research article is accepted, your methods article will automatically be transferred over to MethodsX where it will be editorially reviewed. Please note an open access fee is payable for publication in MethodsX. Full details can be found on the MethodsX website. Please use this template to prepare your MethodsX article.
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
To ensure a fast publication process of the article, we kindly ask authors to provide us with their proof corrections within two days. 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.

Amendments to manuscripts
In order to maintain the integrity of the scientific record, the version that is published in an issue on ScienceDirect and in print MUST be identical. One set of page proofs will be sent to the corresponding author. Please note that authors are urged to check their proofs carefully before return, but corrections are restricted to typesetting errors only. Proofs are NOT to be considered as drafts. No changes in, or additions to, the accepted (and subsequently edited) manuscript will be allowed at this stage. Proofreading is solely the responsibility of the corresponding author.

Offprints
The corresponding author will, at no cost, receive 25 free paper offprints, or alternatively 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 Author Services. 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.

© Copyright 2018 Elsevier | https://www.elsevier.com