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Reporting standards and availability of data, materials, code and protocols

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## Reporting standards and availability of data, materials, code and protocols

An inherent principle of publication is that others should be able to replicate and build upon the authors' published claims. A condition of publication in a Nature Portfolio journal is that **authors are required to make materials, data, code, and associated protocols promptly available to readers without undue qualifications**. Any restrictions on the availability of materials or information must be disclosed to the editors at the time of submission. Any restrictions must also be disclosed in the submitted manuscript.

After publication, readers who encounter refusal by the authors to comply with these policies should contact the chief editor of the journal. In cases where editors are unable to resolve a complaint, the journal may refer the matter to the authors' funding institution and/or publish a formal statement of correction, attached online to the publication, stating that readers have been unable to obtain necessary materials to replicate the findings.

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### Reporting requirements

Nature Portfolio journals aim to improve the transparency of reporting and reproducibility of published results across all areas of science. Before peer review, the corresponding author must complete an [editorial policy checklist](#) to ensure compliance with Nature Portfolio editorial policies; where relevant, manuscripts sent for review must include completed reporting summary documents

### Reporting requirements for research in the life sciences, behavioural & social sciences and ecology, evolution & environmental sciences

Authors of research articles in the life sciences, behavioural & social sciences and ecology, evolution & environmental sciences are required to provide details about elements of experimental and analytical design that are frequently poorly reported in a [reporting summary](#) that will be made available to editors and reviewers during manuscript assessment. The reporting summary will be published with all accepted manuscripts.

### Reporting requirements for physical sciences research

For physical sciences, we require authors of research articles in some specific areas to provide details of characterization, or experimental and analytical design in a reporting summary, which will be made available to editors and reviewers during manuscript assessment and published with an accepted manuscript:

- [Solar cells](#)
- [Claims of lasing](#)

### Reference copies

Please note: because of advanced features used in these forms, you must use [Adobe Reader](#) to open the documents and fill them out. If you would like to quickly view the forms or would like to reference the guidance text as you complete the template, please access a flat reference copy:

- [Editorial policy checklist](#)
- [Reporting summary](#)
- [Solar cells](#)
- [Claims of lasing](#)

We support community efforts to increase transparency and quality of methods reporting. Thus, we have made these templates available for reuse and adaptation with attribution under a [CC-BY license](#).

Guidance and resources related to the use and reporting of statistics are available [here](#).

### Reporting and materials availability requirements for geological, archaeological, and palaeontological research

Details of geological samples, archaeological materials and palaeontological specimens should include clear provenance information to ensure full transparency of the research methods. Samples should always be collected and exported in a responsible manner and in accordance with relevant permits and local laws. Any submission detailing new material from protected sites should include information regarding the requisite permission obtained. Palaeontological and type specimens should be deposited in a recognised museum or collection to permit free access by other researchers in perpetuity. Where applicable, accession codes should be provided for museum depositions, and we encourage deposition of 3-D scans of fossil specimens within a permanent, accessible repository to facilitate study by the scientific community.

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### Availability of data

**Data availability:** All published manuscripts reporting original research in Nature Portfolio journals must include a [data availability statement](#). The data availability statement must make the conditions of access to the “minimum dataset” that are necessary to interpret, verify and extend the research in the article, transparent to readers. This minimum dataset may be provided through deposition in public community/discipline-specific repositories, custom proprietary repositories for certain types of datasets, or general repositories like Figshare, Zenodo and Dryad. Providing large datasets in supplementary information is strongly discouraged and the preferred approach is to make data available in repositories. *Scientific Data*, a Nature Portfolio journal, maintains a list of [approved and recommended data repositories](#) to support researchers seeking suitable repositories for their data. Please refer to our [authorship policy](#) for information about authors’ responsibilities for preserving and making available data, code and materials upon publication. Authors are responsible for obtaining all necessary permissions and ensuring compliance with local regulatory requirements for data sharing.

Mandatory deposition of data is required for certain data types; see table below with

reviewers where requested at the time of submission for the purposes of evaluating the manuscript. Any restrictions on sharing must be discussed with the editor at submission who reserves the right to decline the study if these conditions are found to be unduly prohibitive.

Nature Portfolio journals' data availability policies are compatible with the standardised [research data policies](#) set out by Springer Nature. Authors who need help understanding our data sharing policies, finding a suitable data repository, or organising and sharing research data can access our [Author Support portal](#) for additional guidance.

**Data availability statements should include information where relevant on the following aspects:**

- Information about access to primary datasets (generated during the study) and referenced datasets (datasets analyzed in the study) must be provided. Where data are publicly available, accession codes or other unique identifiers if relevant must be provided.
- **Clinical trial data:** data availability statements for manuscripts reporting clinical trial data should follow the standards set out in the ICMJE recommendations on [clinical trial data sharing](#) and provide the following information:
  - whether individual de-identified participant data (including data dictionaries) will be shared (“undecided” is not an acceptable answer);
  - what data in particular will be shared;
  - whether additional, related documents will be available (e.g., study protocol, statistical analysis plan, etc.);
  - when the data will become available and for how long;
  - by what access criteria data will be shared (including with whom, for what types of analyses, and by what mechanism).
- **Data availability subject to controlled access:** the data availability statement should include the following information: reasons for controlled access (eg., privacy, ethical/legal issues), conditions of access must be described precisely including contact details for access requests, timeframe for response to requests, restrictions imposed on data use via data use agreements. A copy or link to the data use agreement should be provided if requested by editors. Restrictions on controlled access datasets including restrictions on downstream data reuse or authorship requirements must be clearly described in manuscript and to editors at the time of submission. Editors may decline further consideration of the manuscript after evaluation if restrictions are found to be unduly prohibitive.
- **Third party data:** when data obtained from third parties cannot be made available, the restrictions should be clearly stated in the data availability statement. Authors must make data available for purposes of peer review, if requested by reviewers, within the terms of a data use agreement and if compliant with ethical and legal requirements.
- *Proprietary data:* Authors are responsible for ensuring and obtaining agreement with the third party data provider that dataset (s) used in the study will be available under conditions specified in the data availability statement (including whether the dataset will be available for a fee) so as to ensure post-publication availability for replication and verification purposes. Availability for this purpose must be clearly stated in the data availability statement.
- *Administrative data (including data held by governments, local authorities and*

ensure that the data are used in compliance with local regulatory and legal frameworks that govern data use.

· *Identity of third party provider:* the identity of the third party data provider must be made known to the editors at time of submission and peer review. We expect that the data availability statement will state the identity of the third party data source; exceptions may be made for studies where the identity of the data provider is not relevant to the study and/or public release pose a reputational or commercial risk to the data provider. See published examples [here](#) and [here](#).

Researchers should provide information in the manuscript on their data collection methods sufficient to support peer review. If data processing steps were performed by the third-party, out of the control of the authors, this should be clearly stated in the methods. Editors reserve the right to decline consideration if a manuscript fails to provide sufficient information regarding data collection approach.

**Data citation:** Datasets that have been deposited in repositories should be included as formal citations in the article reference list. This includes datasets generated during the study as well as existing datasets analyzed during the study. Citations of datasets should include the minimum information recommended by DataCite and follow Nature Portfolio style including: author(s), title, publisher (repository name), and identifier.

Dataset identifiers including DOIs should be expressed as full URLs. For example: Hao, Z., AghaKouchak, A., Nakhjiri, N. & Farahmand, A. Global Integrated Drought Monitoring and Prediction System (GIDMaPS) Data sets. *figshare*  
<http://dx.doi.org/10.6084/m9.figshare.853801> (2014)

More information about writing data availability statements and data citation is available through the [Springer Nature Research Data policy page](#).

### Mandates for specific datasets

For the following types of data set, submission to a community-endorsed, public repository is mandatory. Accession numbers must be provided in the paper. Examples of appropriate public repositories are listed below and [here](#).

Mandatory deposition	Suitable repositories
Protein sequences	<a href="#">Uniprot</a>
DNA and RNA sequences	<a href="#">Genbank</a>
	<a href="#">DNA DataBank of Japan (DDBJ)</a>
	<a href="#">EMBL Nucleotide Sequence Database (ENA)</a>
DNA and RNA sequencing data	<a href="#">NCBI Trace Archive</a>
	<a href="#">NCBI Sequence Read Archive (SRA)</a>
Genetic polymorphisms	<a href="#">dbSNP</a>
	<a href="#">dbVar</a>
	<a href="#">European Variation Archive (EVA)</a>
Linked genotype and phenotype data	<a href="#">dbGAP</a>
	<a href="#">The European Genome-phenome Archive (EGA)</a>
Macromolecular structure	<a href="#">Worldwide Protein Data Bank (wwPDB)</a>
	<a href="#">Biological Magnetic Resonance Data Bank (BMRB)</a>
	<a href="#">Electron Microscopy Data Bank (EMDB)</a>
Gene expression data (must be MIAME compliant)	<a href="#">Gene Expression Omnibus (GEO)</a>

Crystallographic data for small molecules	<a href="#">Cambridge Structural Database</a>
Proteomics data	<a href="#">PRIDE</a>
*Earth, space & environmental sciences	<a href="#">Recommended Repositories</a>

\*From January 2019, where community repositories are available, we will require data sharing through such repositories for papers in the Earth, space and environmental sciences published in Nature, Nature Geoscience and Communications Earth & Environment. Where such repositories are not available, datasets may be hosted in general data repositories such as Figshare, Dryad or Zenodo. See our [editorial](#) for more details.

### Special considerations

**DNA and protein sequences:** When publishing reference genomes, the assembly must be made available in addition to the sequence reads. Sequence must be deposited even for short stretches of novel sequence information such as epitopes, functional domains, genetic markers, or haplotypes. Short novel sequences must include surrounding sequence information to provide context. The sequences of all small RNA probes central to the conclusions of the paper must be provided.

**Linked phenotype and genotype data for human subjects:** should be submitted to a public repository with appropriate access control (see above). Any restrictions on data access for sensitive data (for example electronic medical records, forensic data, and personal data from vulnerable populations) require an explanation of the nature of and reasons for the restrictions, and details of the conditions under which the data can be accessed or reused. (See the related *Nature Genetics* [Editorial](#) discussing privacy issues.)

**Macromolecular structures:** Official validation reports from the [wwPDB](#) are required for peer review. Atomic coordinates and related experimental data (structure factor amplitudes/intensities for crystal structures, or restraints for NMR structures) must be provided upon request. Electron microscopy-derived density maps and coordinate data must be deposited in EMDB. Accessibility in repositories must be designated "for immediate release on publication."

**Crystallographic data for small molecules:** Manuscript reporting new three-dimensional structures of small molecules from crystallographic analysis should include a .cif file and a structural figure with probability ellipsoids for publication as Supplementary Information. The structure factors for each structure should also be submitted. Both the structure factors and the structural output must have been checked using the IUCR CheckCIF routine, and a PDF copy of the output must be included at submission, together with a justification for any alerts reported.

### Recommendations for other datasets

In addition to these mandates, the preferred way to share any data sets is via public repositories. Scientific Data, a sister publication to Nature Portfolio journals, maintains a [list of approved and recommended data repositories](#) organized by discipline. Please consult this list to identify an appropriate repository for your data sets.

When repositories do not exist for a particular data type, authors can deposit and share data via [figshare](#) or [Dryad](#), two general-purpose scientific data repositories.

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