Disease Models & Mechanisms 2, 423-425 (2009) doi:10.1242/dmm.004259
Published by The Company of Biologists 2009

Resources, repositories and rewards

Vivian Siegel, Editor-in-Chief

By establishing the Resource Article section and stronger policies for materials-sharing and citation, we hope to encourage and properly reward the development and sharing of resources, thereby accelerating research using model organisms to advance human health

Scientific communities prosper on shared information and material, which allow for both confirmation and advancement of research. Journals, as a nexus of communication and as enablers of scientific work, generally, and rightfully, insist that the information obtained and the materials created in the course of doing published work be made available for future research use – the publishing quid pro quo. Yet, while researchers thrive on the acclaim afforded by publishing, many resist sharing their results and reagents – this is perhaps to their advantage in the short term, but to the detriment of expedient scientific progress in the long term. After several frustrated attempts to obtain a published reagent, scientists often end up either making the reagent themselves or changing projects; each year, one in nine scientists abandons a project because of a denied request for 'research input' (material or data) (Walsh et al., 2005; www.casimir.org.uk/storyfiles/66.0.09_00_Walsh.pdf).

For reagents that are simple and cheap to recreate (such as DNA clones), it is often faster to make the reagent than to ask for it. But for those materials that are expensive and time consuming to create, such as the model organisms that are central to the interests of this journal, we need more insistent policies, supportive infrastructures and rewards to ensure the timely sharing of research materials.

Although journals have had materials-sharing policies in place for some time, these policies have largely failed. In 2001, the National Academy of Sciences convened a committee to propose an explicit solution to the problem (www.nap.edu/catalog.php?record_id=10613). From this came UPSIDE: 'Uniform Principle for Sharing Integral Data and Materials Expeditiously'. UPSIDE recommends that authors of publications anticipate which materials are likely to be requested and state within the paper how to obtain them, including the provision of a license to use patented material for research use.

Many funding bodies followed these recommendations. For example, the NIH policy on 'sharing model organisms for biomedical research' states: 'By sharing of research resources and, thus, avoiding the duplication of very expensive efforts to generate model organism models, the NIH is able to support more investigators than if these useful models had to be generated in duplicate by more than one NIH-funded investigator. …all investigators submitting an NIH application or contract proposal…are expected to include in the application/proposal a description of a specific plan for sharing and distributing unique model organism research resources generated using NIH funding so that other researchers can benefit from these resources… Applicants/Offerors are also expected to address as part of the sharing plan if, or how, they will exercise their intellectual property rights while making model organisms and research resources available to the broader scientific community' (NOT-OD-04-042; http://grants.nih.gov/grants/guide/notice-files/NOT-OD-04-042.html). Such 'sharing plans' are now included in most grant applications. Why then, is it still so difficult to acquire published model organisms? And how can journals such as DMM facilitate sharing in new ways? At the core of this issue is the infrastructure required to support sharing.

I recently attended a meeting in Rome that focused on these issues, especially as they pertain to the community of scientists who use mouse models. Organized by CASIMIR

Vivian Siegel is at the Department of Medicine, Vanderbilt University School of Medicine, Nashville, Tennessee, USA
(e-mail: dmmeditor@biologists.com)

(Coordination and Sustainability of International Mouse Informatics Resources), the meeting included the major stakeholders in the world of reagent sharing: funders, repository directors, technology transfer officers, lawyers, social scientists and journal editors. Jack Dixon, Vice President of the Howard Hughes Medical Institute (HHMI), described the HHMI arrangement whereby mice generated by HHMI investigators are sent to The Jackson Laboratory for both maintenance and distribution to the research community. Other mouse repositories exist in the UK, continental Europe, Canada, Australia and Japan.

A straightforward solution to the sharing problem would be a mandatory deposition of model organisms in the appropriate repository as a condition for publication, enforced by journal editors. This approach, suggested in the *Nature* editorial in response to the meeting (Nature Publishing Group, 2009), resembles the current requirements for the deposition of sequences, protein structure coordinates and microarray data. Unfortunately, these repositories do not currently have the capacity to maintain a comprehensive collection of all published model organisms, and most funding agencies – unlike HHMI – do not provide the funds that are required to transfer organisms that are generated by their investigators to repositories (see Behringer, 2009). Funding agencies should promote the expansion of these repositories, the transfer of model organisms into them, and the development of potentially cost-saving alternative methodologies. Until repositories have the capacity to maintain a comprehensive collection, we cannot require deposition of all organisms; however, we encourage deposition of all organisms and have made it our policy that authors publish instructions for obtaining any reagents described in the paper. Furthermore, in papers in which the motive for publication is to announce a resource – such as articles published in our new Resource Article section (see below) – deposition is an absolute criterion for publication.

Sticks and carrots

Stronger policies – and the accompanying penalties for noncompliance – may be insufficient to change researcher behavior. If we really want researchers to share, then we need to reward sharing. In the academic world, where authorship is king, animal models are often shared subject to authorship on any paper that ensues – a 'guest authorship' practice that journals have been trying to stop for some time (Siegel, 2008).

To reward resource development and resource sharing, DMM is instituting a new section of the journal and a new policy. First, we invite articles focused on resources and tools for the DMM community. The standard for these papers is that the resource will help a broad community of our readers; authors of successful submissions do not need to 'use' the resource experimentally except to demonstrate its utility. By publishing articles focused on resource development, we will reward developers with authorship.

Our first paper accepted to this new section appears in this issue: Anastassiadis et al. announce the establishment of the Dre-*rox* system in mice (Anastassiadis et al., 2009). This system uses a recombinase (Dre) from phage D26, distantly related to Cre recombinase, which recognizes distinct DNA sequences (*rox*). These mice will be deposited in the European Mouse Mutant Archive (EMMA) and available for future research use, thereby enabling resource sharing and satisfying our absolute criterion for publication in this section of the journal.

Sauer and McDermott first described the Dre recombinase in 2004 (Sauer and McDermott, 2004), and a patent for Dre recombinase and recombinase systems using Dre recombinase was awarded last year to the Stowers Institute for Medical Research (US Patent 7422889). This publication, therefore, is somewhat unusual in that the authors

do not hold the patent. To clarify the position of Stowers on sharing the Dre-*rox* mice, David Chao (President of the Stowers Institute) provided the following official statement:

'The Stowers Institute considers the sharing of research materials to be an essential aspect of scientific citizenship. In the specific case of dre-rox technology, the Institute owns certain intellectual property, including an issued patent and a pending patent application covering, among other things, "Dre recombinase and recombinase systems employing Dre recombinase." The Institute will allow non-profit organizations to make or use material covered by the Institute's dre-rox intellectual property for non-commercial purposes under terms no more onerous than those contained in the Uniform Biological Material Transfer Agreement. The Institute's policy is to offer for-profit organizations a non-exclusive license (without reach-through royalties) to make or use material covered by the Institute's dre-rox intellectual property for internal research purposes. For other uses by for-profit organizations, the Institute will evaluate requests on a case-by-case basis.'

Because the Stowers Institute is not supplying the mice, I asked for clarification of the material transfer agreement (MTA) requirements. Researchers will not need to sign an MTA to obtain mice from other sources, but will need to contact Stowers if they are performing commercial activities that impinge on Stowers' intellectual property (IP) rights.

Authorship is the first step; crediting authors of resource papers – or indeed, of any paper that contains the announcement of a novel model organism or other reagent – is the second. As a matter of policy, our authors must cite the original source of any published animal models that are used in their work; this is part of the checklist used by our copyediting staff.

We consider it critical to DMM's editorial mission that we promote collaboration, sharing and the development of new tools. By establishing the Resource Article section and stronger policies for materials-sharing and citation, we hope to encourage and properly reward the development and sharing of resources, thereby accelerating research using model organisms to advance human health.

This article is freely accessible online from the date of publication.

REFERENCES

Anastassiadis, K., Fu, J., Patsch, C., Hu, S., Weidlich, S., Duerschke, K., Buchholz, F., Edenhofer, F. and Stewart, A. F. (2009). Dre recombinase, like Cre, is a highly efficient site-specific recombinase in *E. coli*, mammalian cells and mice. *Dis. Model. Mech.* **2**, 508-515.

Behringer, R. (2009). Sharing different mouse strains is not always so simple. *Nature* **460**, 324.

Nature Publishing Group (2009). The sharing principle. *Nature* **459**, 752.

Sauer, B. and McDermott, J. (2004). DNA recombination with a heterospecific Cre homolog identified from comparison of the pac-c1 regions of P1-related phages. *Nucleic Acids Res.* **32**, 6086-6095.

Siegel, V. (2008). Where credit is due. *Dis. Model. Mech.* **1**, 187-191.

Walsh, J. P., Cho, C. and Cohen, W. M. (2005). Science and law. View from the bench: patents and material transfers. *Science* **309**, 2002-2003.