

Tracking the Academic and Commercial Outcomes of Public Domain Biology: *C. elegans* knock outs as a case study

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Issue

Measure the impact of basic science research

Research Questions

Are the resources produced by the *C. elegans* Gene Knockout Consortium and released into the public domain pre-publication used?

If used, how are they taken up by the *C. elegans* research community and in what ways does this resource contribute to the scientific innovation?

Background

Researchers, funding bodies, and society debate the benefits of moving scientific knowledge into the public domain as a means to maximize accessibility and potential use. Here we recognize how potential accessibility impacts use, providing evidence for the impact basic research can have when placed into the public domain. By making basic research publicly available opportunities are created for the development of new scientific innovation which may potentially lead to new ideas deepening our understanding of a particular process, or helping to alleviate the burden of disease.

Here we provide examples of the results from one particular research project with a history releasing data into the public domain. By tracking the use of this particular openly available data source we are able to better understand how an open science system functions. Using the *C. elegans* Gene Knockout Consortium and the community of researchers who use *C. elegans* as a case study of a group which distributes information through the public domain we are able to track the peer-reviewed publications they created with this data and information.

Why Worms?



C. elegans (a type of worm or free living nematode) is a sophisticated multicellular animal which serves as a useful model for the study of human disease, sharing many of the same tissues, organ types, and genes as humans. Early testing of applications with human therapeutic or scientific application is often done in animal models. Of the common model organisms, *C. elegans* is among least expensive and easiest to use for research in development. *C. elegans*'s small size, speed of reproduction, limited maintenance costs and transparent body has made them one of the most commonly used animal models for understanding human gene function and the mechanisms of human pathology.

Access

We are analyzing requests for *C. elegans* Gene Knockout Consortium strains from the *C. elegans* Genetic Center (CGC) as a measure of public domain resources accessed. The CGC as a central repository for *C. elegans* resources tracks all strain requests, including strains from the *C. elegans* Gene Knockout Consortium. Our analysis of strain information highlights the proportion of strains requested, comparing total requests to requests for strains created by the *C. elegans* Gene Knockout Consortium of which 1450 alleles have been deposited. Almost 25% of strains sent out by the CGC came from the consortium and 45% of all strain submissions to the CGC in the last few years come from the consortium collection. This assessment of strain requests further illustrates how the *C. elegans* community is accessing this publicly available resource creating the opportunity for further scientific innovation.

Use

In order to building a better understanding of the role these strains play in the scientific landscape of the *C. elegans* community we are tracking the academic publications which reference the use of the *C. elegans* Gene Knockout Consortium strains. This collection of research outputs provides a systematic description of how public domain data production systems function as a component of the larger system of scientific research and exchange. This rich list of over 700 publications utilizing gk and ok alleles includes fourteen Nature and eight Science articles.

2001	2002	2003	2004	2005	2006	2007
22	24	29	78	114	138	162

Impact

We have developed a survey that is currently being circulated to *C. elegans* researchers. This survey has been sent to all *C. elegans* researchers listed in WormBase and asks researchers about their use of public resources such as WormBase as well as the role that *C. elegans* Gene Knockout Consortium strains specifically play in their work. This survey will provide us with additional understanding of how publicly available (public domain) data is used, shared, and exchanged giving depth to our understanding of how an open science system functions and what role pre-publications resources such as the *C. elegans* Gene Knockout Consortium strains can play in the work of particular researchers. This survey will further contextualize the research practices of *C. elegans* community situating the role that *C. elegans* Gene Knockout Consortium within the This survey was launched in October 2008.

C. elegans Gene Knockout Consortium

The *C. elegans* Gene Knockout Consortium was created in 2001 as a central large-scale production system through which to generate *C. elegans* with knocked out or deleted genes thus creating the tools and worm strains through which other researchers can address specific basic biological and disease-related problems. Jointly managed by Don Moerman and Bob Barstead (at the University of British Columbia and University of Oklahoma, respectively) and funded by Genome Canada and the National Institutes of Health, this project was designed not to conduct research directly, but rather to provide the research materials through which scientific advances can be developed.

The goal of the consortium is to knock out every annotated gene in the genome one by one. The order in which this is done is established by the research community as they enter requests for mutant alleles of particular genes. The consortium is a prime example of open source, public domain science as it shares all data and reagents with the public prior to any publication.

The GKC provides data to the public through a policy which could be characterized as public domain or open data, by forwarding all worm strains to the *C. elegans* Genetics Center, and all data to Wormbase. Genetic material, data and worms are made freely available to everyone, without restrictions from copyright, patents or other proprietary mechanisms. The creators of this scientific data currently have not stated conditions of ownership, licensing, or re-use and have placed no claims on commercial outcomes arising from the use of this data.



Moerman Lab Paintball Expedition

Anticipated Outcomes

The embedded GE3LS team is continuing to analyze the role that the pre-publication public domain resource release practices of the *C. elegans* Gene Knockout Consortium have on the *C. elegans* research community. This work illustrates some of the roles that data released into the public domain can play in furthering scientific innovation.

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