RESEARCH SERIES
vol 03

COMMONS LAB

Wilson Center

MANAGING INTELLECTUAL PROPERTY RIGHTS IN CITIZEN SCIENCE

A GUIDE FOR RESEARCHERS AND CITIZEN SCIENTISTS

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Cover Design: Jeremy Swanston
Layout Design: Angelina Fox

Scassa, Teresa & Chung Haewon. Managing Intellectual Property Rights in Citizen Science: A Guide for Researchers and Citizen Scientists. Washington, DC: Woodrow Wilson International Center for Scholars (2015).

Copies are available for download free of charge at:
http://www.wilsoncenter.org/publication-series/commons-lab

This report is funded by the Alfred P. Sloan Foundation and published through the Woodrow Wilson International Center for Scholars, in Washington, DC.

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COMMONS LAB

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The Commons Lab of the Science and Technology Innovation Program is supported by the Alfred P. Sloan Foundation.

ACKNOWLEDGEMENTS

We gratefully acknowledge the support of the Commons Lab of the Woodrow Wilson Center for International Scholars for this project. Many thanks to David Rejeski for his overall guidance, and to Elizabeth Tyson and Anne Bowser for their careful reading of drafts of this text, and for their helpful comments and suggestions. Thanks as well to the anonymous peer reviewers for their very thoughtful and useful feedback. We gratefully acknowledge the support of Lea Shanley, former Director of the Commons Lab, who initiated this study before transitioning to her new position. We also acknowledge with appreciation those directors or coordinators of citizen science projects who took the time to respond to our survey.

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CONTENTS

EXECUTIVE SUMMARY

Citizen science involves "a form of collaboration where members of the public participate in scientific research to meet real world goals."[1] Citizen science rests on the idea that collaboration can create and harness synergies that lead to innovation; that more minds may generate better and more robust outcomes; and that the distribution of tasks over a broad base of participants can facilitate research and innovation on a scale that might be hard to match otherwise. Intellectual property (IP) rights in scientific research are often of great significance to researchers whose career advancement may depend upon the ability to publish their work in select journals, to maintain the confidentiality of their research results until they are ready to publish, or to obtain patents. Citizen science research can be quite different in many respects from conventional scientific research because it involves large numbers of non-professional participants; nonetheless, it can still give rise to IP considerations. Citizen science may also present IP issues that are relevant to citizen scientists who are invited to be part of projects: sharing facts, observations, photographs, or even inventive ingenuity. Intellectual property issues carry over into the dissemination of citizen science research for both researchers and citizen scientists, particularly since the very nature of such projects, combined with community and participant expectations, may demand forms of dissemination different from the traditional method of sharing research through proprietary peer-reviewed publications. Conducting scientific research publicly with non-professional participants may create an expectation that the research be openly available for re-use by other scientists, and for use by ordinary citizens for education and community development. In many instances, the need to manage IP rights in citizen science may be less about ownership and control for the purposes of career advancement or commercial exploitation and more about appropriate management to serve a broader public interest.

Part I of this study provides an overview of the areas of IP law most relevant to citizen science. Copyright, patent, trademark and trade secret law is discussed, with specific reference to the citizen science context. In addition, consideration is given to the protection of traditional knowledge. While the IP issues identified in Part I are similar around the world, there may be important differences in how different national laws apply in specific instances. The reader should note that this study focuses on US law, with some references to the laws of other countries.

Copyright law is the area of IP law that is most important in the citizen science context for a number of different reasons. In the first place, copyright law is relevant to many of the different types of works that are created in the course of research (including compilations of data, software, research papers and publications). It is also relevant to content or infrastructure that is used in the design or implementation of the project, such as databases of images licensed from third parties or third party platforms for hosting projects. When citizen science participants have rights in their own contributions to projects, they are most likely to be copyrights. For example, participants may contribute photographs, videos or written observations in which copyright subsists. Copyright law is also significant because, unlike many other areas of IP law, these rights arise automatically and without the need of any active steps by the creators of works. Therefore, a failure to plan for, apply for, or register copyrights does not actually stop these rights from coming into being – or from posing problems at some future point where research outputs are about to be shared or used. Researchers should not simply ignore copyrights; instead, they will be better off planning for and managing them.

In contrast to copyrights, **patent rights** arise only where inventors take concrete steps to participate in the rigorous patent application process. There are no accidental patents. However, this does not mean that patent-related issues should be ignored in the design of citizen science projects, particularly in situations where patentable inventions may be one of the research outputs. Citizen science activities can include sharing innovative ideas, creating designs, and developing products; in such cases, the patenting of an invention may be an explicit goal of the project. Although the threshold for inventive activity that turns a contributor into an inventor under patent law is quite high, it is possible that in some projects exceptional participant contributions of a particular kind may reach this threshold. Further, where patenting may be a goal of researchers, and even where citizen scientists' contributions are unlikely to rise to the level of patentability, researchers must still be aware of the risks that too-broad sharing of information prior to the filing of a patent application may result in a loss of patentability.

Although **trademark law** – with its focus on protecting signs or symbols that are indicators of source – may seem far-removed from citizen science, this is not always the case. High profile and highly successful citizen science projects may garner considerable media and other public attention. Researchers can use trademark protection to prevent others from exploiting commercialization opportunities relating to the project such as the sale of merchandise or the provision of services. For example, a copycat commercial-oriented project might choose a confusing name or logo to exploit the goodwill associated with a high profile citizen science project. Trademark considerations may be relevant to the choice of a name for the project (distinctive names are far better than descriptive ones); it is also important to avoid choosing a name that might cause confusion with a trademark registered by another party. It may also be that researchers will wish to place limitations on certain uses of project trademarks by users of their site or its contents in order to avoid the impression that they are in any way endorsing downstream uses of their research data or other materials.

Traditional knowledge forms a part of indigenous knowledge systems and may be governed, within indigenous communities, by a set of norms quite distinct from IP law. Although Western IP laws do not generally recognize or protect traditional knowledge unless it is embodied in some form that is recognized as conventional IP, researchers who involve indigenous communities in citizen science research should be aware that different principles may apply to their use of information contributed by indigenous communities or their members. An awareness of such issues is essential in project design and implementation.

The Local Environmental Observer Network is an example of traditional knowledge in service of observing environmental change. Tribes in Alaska design and report on various environmental observations to help inform climate change.

The law of **confidential information or trade secrets** may also be important to researchers who seek to protect their research data from disclosure until they are ready to publish or to make a patent application. Even in projects where researchers ultimately plan to share all or part of their research data with others, there may be a period within which confidentiality is required. In order to qualify for legal protection, certain steps are required, and these must be taken into consideration in project design.

Part II of this study considers the relationship between **IP and ethics**. The ethical conduct of citizen science research is a matter of growing interest within the citizen science community. IP management in citizen science has ethical dimensions because IP rights regulate a series of relationships between individuals and in relation to intangible goods. Citizen science projects often maintain a hierarchical structure, with the research projects designed, controlled and driven by scientific researchers. The different status of researchers and citizen scientists within the collaborative space makes it necessary for important decision making tasks, such as IP management, to be carried out ethically to sustain trust between collaborators.

Also, there are a number of different ways in which ethics intersect with IP issues. Debates over appropriate attribution of co-authors and contributors are well-known in academic circles; these issues may arise in citizen science, as well, depending upon the nature and extent of participant contributions. Thus, when the contributions of a citizen science meet the threshold for co-authorship this raises both ethical (appropriate recognition of the contribution) and IP issues (joint ownership of copyright in the co-authored work). The collection and use of traditional knowledge through citizen science also raise complex ethical issues. These relate to the nature and form of consent required for the collection and use of the traditional knowledge, as well as to issues of custodianship of the information and control over downstream uses. Another consideration is whether researchers who involve the public in gathering research data have an ethical obligation to make that data openly available and/or to publish any research results in open access publications. These issues may be particularly important

where projects are community-based, and where participants have their own goals for the research (such as political activism). Considerations of this kind are important as well to the thoughtful design of citizen science research projects.

Part III of this study focuses on the **management of IP rights** in citizen science by explaining how an IP license may come into existence and how such licenses apply in the citizen science context. A key argument in this study is that researchers should take IP considerations into account in the design and implementation of their projects. For example, inviting simple and mechanical contributions of data using electronic forms will minimize the likelihood that contributors will be able to claim any IP rights in their contribution, whereas inviting the same contributions as written observations or photos, may raise copyright considerations. Beyond design choices, terms of use for the project website can incorporate key provisions regarding how contributors may or may not make use of IP that is part of the project (such as databases or images or other materials), as well as the terms and conditions under which contributors provide any copyright-protected materials to the project. Where researchers plan for the publication or dissemination of research outputs or data, licensing can be used to set terms and conditions for any downstream uses of these materials. Researchers can look to existing projects for examples, use template licenses and/or they may create their own policies to manage IP rights in a manner that matches their project's goals and objectives.

The report concludes with a set of **best practices for IP management** in relation to citizen science projects. We provide a detailed table that outlines important questions and considerations in relation to IP management, including project design, the contributions of citizen scientists, and the sharing and use of research results. Included in this table are references to the parts of this report which elaborate upon these topics. Rather than complicate citizen science research, our goal is to raise awareness of potential issues and to allow researchers and participants to anticipate and address them at the earliest possible stage.

The questions around ownership and control of data and research results for the purposes of publication, dissemination, and even patenting are matters of importance for researchers, funders and participants in crowd-sourced scientific research. As a prerequisite to proper IP management in citizen science, researchers who engage in citizen science should seek clarity about the nature and scope of their rights and those of participants. Much scientific research is also funded by public and/or private sources, and such entities may make funding conditional on full or part ownership of any resultant intellectual property, or they may require open forms of access and dissemination. Participants in citizen science projects should be aware that IP rights may also be a matter of concern, particularly where they seek to use the data to solve problems in their own community, where they wish to have access to the fruits of their contributions, or where they seek to be rewarded in some way for exceptional contributions. This study explores these issues in order to help the field of citizen science to reach its potential and to meet expectations of researchers and participants.

INTRODUCTION

This study identifies and explains intellectual property (IP) issues that are raised by citizen science projects, taking into account the perspectives of researchers, participants and the broader public. One of the challenges of discussing IP rights in the context of citizen science is the almost unbounded nature of "citizen science". For example, Bowser and Shanley define citizen science in broad terms as "a form of collaboration where members of the public participate in scientific research to meet real world goals."[2] The recent Citizen Science Association 2015 Annual Meeting included presentations that ranged from community-based research projects, to online participatory projects, to projects that could as easily be defined as open innovation. Indeed, "citizen science" is only one of many labels for a wide range of related activities. Other labels include: "public participation in scientific research, volunteer monitoring, crowdsourced science, democritized [sic] science, and participatory action research."[3] Shirk et al. are attuned to this breadth of the concept of citizen science, noting that the term is used to refer to projects ranging from "large scale data-collection initiatives"[4] to the engagement of "public perspectives and knowledge in science discourse and policy making."[5] An overly broad definition of citizen science could make a discussion of IP rights almost unmanageable. As a result, our primary focus in this study is on citizen science projects led by researchers in institutional settings (such as universities or research institutes).

IP issues arise in citizen science in a variety of different ways. Indeed, the more broadly the concept of citizen science is cast, the more diverse the potential IP interests. Some community-based projects, for example, may well involve the sharing of traditional knowledge, whereas open innovation projects are ones that are most likely to raise patent issues and to do so in a context where commercialization is a project goal. Trademark issues may also arise, particularly where a project gains a certain degree of renown. In this study we touch on issues of patenting and commercialization; however, we also recognize that most citizen science projects do not have commercialization as an objective, and have IP issues that flow predominantly from copyright law.

By its nature, citizen science shifts the conventional paradigm for scientific re-

search. Bowser and Shanley observe that "Citizen science is also considered a paradigm where the needs and activities of an engaged public are intertwined with professional scientific research." This suggests a coming together of separate but equal motivations. In community-based participatory science projects, for example, community members may have specific needs or goals (e.g. to document water or air quality issues with a view to improving community health). These goals combine with the researchers' broader scientific objectives in studying air and water quality issues. In some cases, public participation may be an effective means to an end (where, for example, it is the most efficient way of collecting a large number of samples over time); in other cases, scientists may have objectives that include raising public awareness, empowering local communities, or sharing scientific knowledge with a broader public. Citizen science projects tap into a broader movement towards collaborative co-creative online endeavors; when they do so they may also embrace similar goals of open access and the democratization of knowledge.[6] These dimensions of citizen science bring other IP considerations into the fore. In such cases, IP is generally managed not in order to preserve commercialization potential, to preserve the ability to publish in top-ranked closed-access journals, or to maintain an edge within a competitive research environment. Rather, IP is managed so as to ensure participant access to research outputs and, where appropriate, to enable broad sharing of research data with the public.

This study is an exploration of IP issues in relation to citizen science. As part of our study we conducted a voluntary online survey of project coordinators of active citizen science websites. Responses to the survey have informed our understanding of how researchers consider IP issues in the design and execution of their projects. Part I of this study discusses the many different IP issues that may arise in relation to citizen science projects from the points of view of researchers, citizen scientist participants, and the public at large. Citizen science projects may raise a broad range of IP issues, from copyright and patent issues, to trademarks, trade secrets and traditional knowledge. Using examples from the citizen science context we examine and explain how these different issues might arise, and what some of their implications may be if left unaddressed.

While the basic IP issues that arise in citizen science will be the same or very similar around the world, differences in the laws of each jurisdiction can affect how specific issues are addressed. This report focuses on U.S. law. In some cases we flag significant differences between U.S. law and that of other jurisdictions. Depending on the context, these differences may be relevant to decisions about where to locate particular projects. This highlights the importance of IP considerations in the planning and development of citizen science projects.

Part II of this study considers the relationship between IP and ethics. The ethical conduct of citizen science research is a matter of growing interest within the citizen science community, and we explain how the protection and management of IP rights in citizen science has ethical dimensions. For example, if researchers engage the public in gathering data for a particular project there may be an ethical obligation

to make that data openly available and/or to publish any research results in open access publications. Considerations of this kind are important as well to the thoughtful design of citizen science research projects.

Following on the extensive discussion of the nature and occurrence of IP rights in citizen science, Part III of this study focuses on the management of these rights. A key argument in this study is that researchers should take IP considerations into account in the design and implementation of their projects. In this section we look at the tools that are available to assist researchers in doing so. We discuss the nature of IP licenses and user agreements related to citizen science projects, giving concrete examples of each, and of how different projects have used terms and conditions in order to manage IP.

Part VI of this study is a set of best practices to guide researchers who seek to address IP issues in the design and implementation of their projects. It also provides citizen scientists with a check list of IP considerations that they may wish to take into account before participating in a citizen science project. There is no single way for researchers to address IP issues in citizen science. The diversity of types of projects and the diversity of goals and outcomes mean that each project will have its own unique constellation of considerations. What we have sought to do is to identify and explain the rights that may be at issue, to address why these are important and what consequences might flow from failing to address them, and to offer suggestions and guidelines as to how they might be addressed.

IP rights and IP considerations should never be a brake on innovative ideas for increasing public engagement with scientific research. Our goal in raising these issues is not to create problems or disincentives for citizen science projects or participation. Rather, we hope to identify issues and solutions with a view to allow researchers and participants to address IP issues upfront in ways that may help them address their expectations, reduce potential IP conflicts, and encourage downstream uses of project output.

INTELLECTUAL PROPERTY RIGHTS, INNOVATION AND COLLABORATION

Intellectual property rights arise in works of human intellect and creativity. Broad public policy goals are served by the protection of intellectual property rights. These are reflected in the United States Constitution, which grants Congress the power "To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."[7] In general, this progress is considered to be promoted by the grant of monopoly rights in two main ways. First, by providing for the exclusive rights to commercially exploit their works, authors and inventors are given an incentive not just to create those initial works, but to continue to engage in creative or inventive endeavors. While authors and inventors benefit from these rights, the public also benefits, as the pool of creative or inventive works continues to expand. However, the Constitution also provides that the exclusive rights are for "a limited time." The public benefits again when the protected works fall into the public domain and may be freely exploited. The public interest is also served by a range of exceptions (more extensive in copyright law than in patent law) to the exclusive rights of authors/owners. These exceptions allow for certain uses of the works to be made without infringing on intellectual property rights in circumstances where the use serves the public interest.[8]

This balance between the private interests of authors and inventors (and by extension the corporate interests that acquire and exploit patents and copyrights from their authors and inventors), and the broader public interest in access to and use of works is crucial, but it has come under increasing stress in recent years. Digitization and the internet have made works much easier to reproduce and to share. This has led rights-holders to push for increased terms of protection,[9] expanded categories of intellectual property protection,[10] and greater powers of enforcement.[11] In response, a users' rights movement has grown in strength, alongside a movement towards greater collaboration and co-creation of works, and the open sharing of these works for purposes that serve the broader public interest.[12] Examples of movements that support open collaboration, co-creation and sharing are found in Table I.

Citizen science is influenced to some extent by this drive towards more open collaboration, and many (although not all)

TABLE I: Movements for Open Collaboration, Innovation and Dissemination

Movement	Objective
Creative Commons http://www.creativecommons.org	Provide a suite of template open licenses to encourage and facilitate the open licensing of copyright protected works
Open Science Project http://www.openscience.org	To encourage "writing and releasing of free and Open Source science software"
Open Data Commons http://opendatacommons.org	Provide a suite of template open licenses to facilitate and encourage the open licensing of data
Open Science Commons https://www.opensciencecommons.org	To enhance sharing and collaboration with a view to furthering scientific discovery through open access to data, infrastructure, scientific instruments and knowledge
Citizen Cyberscience Centre http://www.citizencyberscience.net	Support an open source approach to citizen science by developing open source tools and projects
Open Street Map http://www.openstreetmap.org	Share a collaboratively developed map of the world that is available for use under an open license
Public Library of Science http://www.plos.org	Non-profit organization committed to open access scientific publishing
Informal Science http://informalscience.org http://informalcommons.org	Collection of resources and materials relating to informal science education
Public Labs| http://publiclab.org	Provide tools and resources for community-based environmental monitoring

citizen science projects share, at least in part, the vision of these movements.[13] Citizen science rests on the idea that collaboration can create and harness synergies that lead to innovation; that more minds may generate better and more robust outcomes; and that the distribution of tasks over a broad base of participants can facilitate research and innovation on a scale that might be hard to match otherwise. However, as Wiggins & Crowston note, citizen science projects are different from many other forms of peer production in that they generally maintain a hierarchical structure; many projects are designed and led by scientific researchers.[14] This hierarchical relationship is an important factor in the discussion of intellectual property rights and ethics in citizen science.

"In this context, the need to manage intellectual property rights may be less about ownership and control for the purposes of career advancement or commercial exploitation;[16] rather, intellectual property rights may require appropriate management so as to serve a broader public interest."

In spite of this difficult dynamic, the ethic of collaboration that is nonetheless present in citizen science can be empowering, enabling and engaging; many citizen science projects seek not just to produce viable research results, but also to engage the public in scientific activities, in community enhancement, and in capacity building.[15] In this context, the need to manage intellectual property rights may be less about ownership and control for the purposes of career advancement or commercial exploitation;[16] rather, intellectual property rights may require appropriate management so as to serve a broader public interest. How researchers address issues of ownership and management of IP rights within a citizen science project is a reflection of the relationships between researchers, their institutions, and public participants.

INTELLECTUAL PROPERTY RIGHTS IN CITIZEN SCIENCE

Citizen science projects may engage several different intellectual property rights. In the discussion below, we consider copyright, patent and trademark law, as well as the protection of traditional knowledge and confidential information. As noted earlier, while many of the basic IP issues will be common across jurisdictions, the discussion below focuses on U.S. law, with occasional references to the law in other countries.

Copyright

Copyright subject-matter in citizen science

Copyright law provides copyright owners with exclusive rights over the exploitation of their works. It protects "original works of authorship fixed in any tangible medium of expression, now known or later developed, from which they can be perceived, reproduced, or otherwise communicated, either directly or with the aid of a machine or device."[17] This is a very broad definition, and, in fact, the Copyright Act goes on to list a number of different types of works that fall within this category. The most important categories in the context of citizen science are likely to be: literary works (which would include written expression of all kinds, including computer software); pictorial and graphic works (which could include photographs, tables, charts and drawings); audiovisual works (which would include video footage, video recorded interviews and so on); and sound recordings (which may include recorded interviews, bird or animal noises). Many of the outputs of citizen science research are also protected by copyright. These would include: journal articles, software, research notes, conference papers, audio or visual presentations, and teaching or learning materials.

Copyright law also protects compilations, which are essentially works created from the combination either of other copyrighted works or of facts. The scope of copyright in compilations, however, is limited to the author's contribution in compiling the materials. It "extends only to the material contributed by the author of such work, as distinguished from the pre-existing material employed in the work, and does not imply any exclusive right in the pre-existing material."[18] Thus, the creator of a compilation has copyright ownership in the compilation as a whole and the copyright protection extends to the creator's original effort in selecting and arranging its contents; the creator does not hold copyrights in individual items in the compilation.

Examples of compilations of other works include scientific journals or collections of papers. Citizen science websites (which may consist of a combination of text, photos, video clips, graphic design and other elements) are also a form of compilation. In the case of compilations of other works, such as an issue of a journal, each article in the journal may be separately protected as a literary work, and the authors of each article might hold the copyrights in them. The author of the compilation would have copyright in the journal as a whole for his or her original effort in selecting and arranging the published articles. Compilations of facts – such as a collection of research data, or even a map[19] – can also be protected under copyright law.

Some things are excluded from the scope of copyright protection for public policy reasons. Thus, for example, copyright does not "extend to any idea, procedure, process, system, method of operation, concept, principle, or discovery, regardless of the form in which it is described, explained, illustrated, or embodied in such work."[20] This exclusion serves to emphasize that what is protected is the author's original expression, but not the underlying ideas, principles or discoveries. Copyright law is simply not intended to give a monopoly to anything other than the expression embodied in works of the intellect. For example, the copyright in a scientific journal article

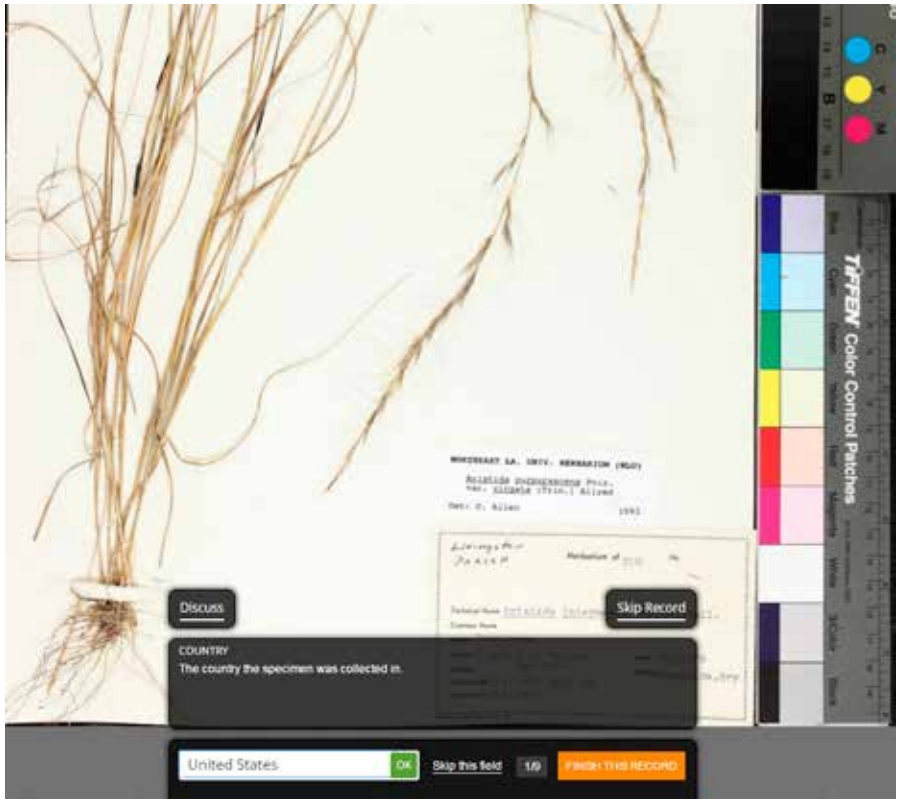
that describes a particular process extends only to the article itself (i.e. the expression of ideas) and not to the process or to any other ideas expressed in the article. One cannot obtain monopoly rights in a theory simply by writing about it.

The same principle holds true for facts. The U.S. Supreme Court has made it clear that copyright cannot be used to obtain a monopoly over facts – facts are the raw material of creativity and innovation, and giving exclusive rights over facts would not serve the public interest.[21] Thus, although scientific research may lead to the creation of a compilation of facts, any copyright in the compilation will not extend to the data itself. What is protected is only the authorial effort in creating the compilation – in other words, the author's original selection or arrangement of the data. It is often the case in scientific research that the selection of data that makes up a compilation is original – for example, the data may flow from an originally conceived and designed research project. However, in some cases, the goal may simply be to create a catalog – for example, to compile a list of all known insect species found within a particular area. There is some question whether this could amount to an original selection.[22] Copyright may still exist in a compilation that does not feature an original selection of facts if the arrangement of those facts is original. However, some arrangements are not likely to be considered sufficiently original to give rise to copyright protection.[23] Thus, a list of all insect species found in a given area that is arranged in alphabetical order, for example, would not necessarily reflect an original arrangement of the data. As a result, copyright in databases or compilations of fact are often "thin"[24] or "relatively weak".[25] Any such rights are also

Database Protection: *The European Response:*

In Europe, the rather thin copyright protection available for compilations of data is supplemented by a separate regime for the protection of databases. A database is defined in the EU Database Directive as "a collection of independent works, data or other materials arranged in a systematic or methodical way and individually accessible by electronic or other means." Protection extends to databases where there has been "qualitatively and/or quantitatively a substantial investment in either the obtaining, verification or presentation of the contents." This means that the *EU Database Directive* may provide protection for databases that would not qualify for copyright protection. Database protection is for a term of 15 years; a new 15-year term is available each time the database is substantially revised. Database protection can extend to the contents of the database, since the database right is infringed by the extraction of a significant part of the data, assessed either qualitatively or quantitatively.

There is no equivalent to the database directive in the U.S. or Canada.



Notes from Nature. ***Screenshot taken from website.***

contingent in the sense that their existence or scope is not always clear, unless these issues have been litigated.

As seen from the above, the scientist-researcher may have copyright in a broad range of inputs and outputs related to any citizen science project they initiate. Copyright will subsist in photographs, charts, graphs, tables, journal articles, blog posts, websites, and compilations of data. However, the researcher may not be the only party with copyright interests in a citizen science project. The participants may have copyright in elements they have contributed to the project, and third parties may also have copyright interests.

i) Participant contributions

The broad diversity of citizen science projects means that there is a corresponding diversity in the types of contributions which citizen scientists are invited to make. A typology of citizen science projects from an IP perspective identified 4 main categories of activities in terms of their potential IP consequences.[26] In cases where citizen scientists are predominantly involved in classification or transcription activities that tend to be mechanical rather than creative efforts, they are less likely to have copyright interests. For example, in a project where the citizen scientist is invited to view video footage so as to identify or classifying objects or animals seen in the images by

International IP Dimensions:

International intellectual property treaties have resulted in a considerable degree of harmonization of norms for most types of intellectual property. However, each country will implement these treaties in its own way, and there can be divergences from one country to the next with respect to different issues. For example, it is possible for the courts of one country to decide that a satellite image is not an original work in which copyright subsists; the courts of another country might decide otherwise. Another example is that under U.S. law, there is no copyright in works of the federal government. In most other countries, the national government can and does hold copyright in its works (including compilations of data.)

following the instructions given to them, this form of activity is not likely to give rise to IP rights for citizen scientists.[27] This is particularly the case where researchers have adopted an interface which invites participants to record their observations through online forms with check boxes.[28] Activities that involve transcription – such as the transcription of ships logs in Old Weather[29] – also do not give rise to participant copyright, since the typing up of words written by another is not a creative activity but rather one that involves accurate copying.[30]

Many citizen science projects involve participants in data gathering activities. This may involve them in observing wildlife (such as with the eBird project, for example),[31] or monitoring environmental conditions.[32] Where observations are to be recorded on structured online data submission forms, the participant is really only contributing facts to the project, and there is no copyright in facts. In cases where participants are collecting and submitting water or soil samples, for example, there is similarly nothing in which copyright would subsist. The use of specialized equipment that has been provided by project organizers in order to record or submit data is also not an activity that would, on its own, give rise to a "work" authored by the participant. In these cases, the participant may be recording data, but they are not expressing it through their own original selection or arrangement.

However, some projects that involve participants in observation activities also invite them to submit photographs or to provide text-based written observations in the participants' own words.[33] Other projects may require a great deal of back and forth, text-based exchanges, which may, depending on the circumstances,

"In either case, the participant may create a work (a photograph, or written expression, as the case may be) in which copyright subsists. The fact that the participant has contributed this work to the project does not, by itself, constitute a transfer of rights in the work."[35]

give rise to rights in the expression.[34] In either case, the participant may create a work (a photograph, or written expression, as the case may be) in which copyright subsists. The fact that the participant has contributed this work to the project does not, by itself, constitute a transfer of rights in the work.[35]

ii) Third Party Copyrights

There may also be third party copyrights implicated in citizen science projects. For example, the project itself may be hosted on a third party's online platform, and that third party may have proprietary rights in that platform.[36] For example, some projects may make use of Facebook as a forum for participant interactions or for the dissemination of information about the project. In cases where a proprietary platform is used, the terms of use for that site may provide that all user contributions protected by copyright are licensed in a particular way. For example, the Facebook Terms of Service provide that: "you grant us a non-exclusive, transferable, sub-licensable, royalty-free, worldwide license to use any IP content that you post on or in connection with Facebook (IP License)."[37] When participants are invited to contribute photographs or written observations in citizen science projects hosted on such a third party platform or when a portion of citizen scientists' activity occurs on a third party website, the citizen science experience will include participants being bound by the third party license.

Similarly, in cases where participation involves collaborative writing using a cloud service such as Google Drive, or SkyDrive, researchers should be aware that the terms of use for such sites may require users to licence contributed materials to the third party service. For example, the Terms of Service for Google Drive provide that the user of the service grants Google "a worldwide license to use, host, store, reproduce, modify, create derivative works [. . .] communicate, publish, publicly perform, publicly display and distribute such content."[38] Some proprietary platforms may be available for use under an open license. This may be a platform such as Zooniverse[39] which is made available under an open license. However, not all open licenses permit unrestricted use of the materials. Thus, for example, Open Street Map (OSM) may be used as a platform for map-based visualizations of project data, but OSM requires that derivative works created using its maps be licensed under the same terms.[40] This may be a problem where the researcher has other commitments regarding publication or dissemination that make share alike licensing undesirable or unfeasible.

In some cases, the research materials made available on a citizen science website are ones in which a third party holds copyright. This might be the case, for example, with a project that invites users to examine satellite photographs, video footage of the ocean floor, or images captured by space telescopes. While there may be interesting issues as to whether copyright subsists in satellite images or video footage captured by cameras placed in fixed locations (since copyright requires a human author),[41] rights in these materials may still be asserted by a third party.[42] It is also worth noting that the assessment of whether copyright subsists in such images may be different from one country to the next, thus raising further complications.[43] Although the US government does not

have copyright in its works (these fall immediately into the public domain)[44] this is not the case with all national governments.[45] Thus, where satellite imagery or other materials are obtained from space agencies in other countries, there may be intellectual property rights that pertain to these materials.[46] Typically, however, third party content providers will have negotiated with citizen science researchers and will have established terms and conditions to access and use the third party material. As a user of third party material, citizen scientists may need to be informed about these terms and conditions of use. Some citizen science projects use open-source materials.[47]

iii) Government Copyright

As noted above, the United States is different from countries such as Canada, the U.K., Australia and New Zealand in that its copyright legislation specifically provides that there is no copyright in any work of the federal government.[48] In the other named jurisdictions, the concept of "Crown copyright" gives government copyright in any works created through its operations. In principle, then, works of the federal government in the U.S., including compilations of data, reports, studies, photographs, maps, or other documents are in the public domain. It is important to note, however, that state governments in the U.S. can assert copyright in their works. Governments in the 'crown copyright' jurisdictions also regularly assert copyright in their works, although they may make some works available for reuse by the public under open government licences.

Where a federal government department or agency is initiating a citizen science project in the U.S., the lack of government copyright may have important implications for rights in the resultant compilations of data or publications – essentially, these will be in the public domain. By the same token, citizen science activities carried out by governments in jurisdictions where governments may hold copyright in any "works" flowing from the activities of their departments or agencies may fall under Crown copyright.

Term of protection and formalities

The statutory copyright monopoly lasts for the life of the author of the work plus an additional 70 years from the end of the calendar year in which the author dies.[49] This is a significant period of time. Further, while registration of the copyright in a work is possible, it is not required.[50] Essentially, once an original work is created and fixed in some form, it is automatically protected under copyright law. It is not even a requirement that a work be marked with a © or other form of notice in order for copyright to subsist. Of course, the use of the © or the terms "copyright" or "copr." accompanied by the date of creation and the author's name can serve important notice requirements that have evidentiary value in any legal proceedings.[51]

Up to this point, we have referred to the researcher holding copyright in some aspects of their project (such as the website, electronic forms, instructions or other written materials provided to participants, training videos, photographs, compilations of data and so on). Indeed, the basic default rule in copyright law is that the author of a work is its first owner.[52] However, the "work for hire" doctrine creates an im-

portant modification of this principle. This doctrine provides that: "In the case of a work made for hire, the employer or other person for whom the work was prepared is considered the author for purposes of this title, and, unless the parties have expressly agreed otherwise in a written instrument signed by them, owns all of the rights comprised in the copyright."[53] Where the researcher is an employee of a research institute or university, for example, the ownership of copyright in materials related to or flowing from the citizen science project may rest with the researcher's employer by virtue of the employment contract. Of course, the work-for-hire doctrine is subject to any written and signed agreement to the contrary. In some cases, research institutions or universities enter into agreements with their researchers that allow them to retain copyright in some or all of the works they produce in the course of their employment.[54] Awareness of any such agreements and their terms are important in understanding the location of ownership rights in citizen science projects.

Transfer and licensing

An owner's copyright can be transferred to another (for example, sold), in whole or in part.[55] Any transfer of ownership must be pursuant to a signed written agreement.[56] A transfer effectively changes ownership of the copyright. A licence, by contrast, occurs where the owner of the copyright grants permission to another to make some use of the work that falls within the owner's exclusive rights. A license may be express or implied, oral or in writing. Creative Commons[57] licenses are an example of express licenses. [For other examples, see Table II]. Using one of these licenses, the owner of copyright gives permission to others to make use of the licensed work according to the specific terms of the license. These might include a requirement to provide attribution where the work is used, or may limit uses only to non-commercial purposes. An express license may be lengthy and detailed, but it may also be a simple statement of permission to make a particular use of the work. In contrast to an express license, a license may be implied in circumstances where it seems apparent that permission to perform a certain act is granted. For example, posting material to a website can be said to give rise to an implied license for users to reproduce this material on their computer screens when they visit the website.

The online terms of use for a citizen science project may contain, among other things, copyright license terms. For example, the terms of use may provide that some content made available through the site is licensed under certain terms and conditions (such as a Creative Commons license).[58] The terms may also provide that users who contribute text or photographs to the project do so under particular conditions. For example, a license might provide that participants who upload photographs to the project site grant the researchers a perpetual, world-wide, royalty-free, non-exclusive license to reproduce, display and to distribute the work.[59] Terms of use and licenses are discussed in much greater detail in Part IV below.

Infringement

Copyright infringement occurs when anyone who is not authorized to do so, performs any of the acts that fall within the exclusive rights of the copyright owner.[60]

The reproduction of a work without permission, for example, is copyright infringement. Since the unauthorized distribution of works is also infringement, distributing copies of works over the Internet would also infringe copyright.

Perhaps because of the very long duration of copyright protection, and because of the fact that copyright law protects "expression", there are a number of significant exceptions to copyright infringement. The most well-known of these is the "fair use" exception. This exception provides that it is not an infringement of copyright if certain types of use are made of the work, and the use itself is "fair". The types of uses that are privileged by the fair use exception tend to be those that serve important public interests, including free speech. Examples include: "criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research".[61] This is not a closed list, and activities such as parody and "transformative" uses have also been found to be fair uses.[62] The *fairness* of any use must be separately assessed. The criteria used for determining whether any use is fair are:

> (1) the purpose and character of the use, including whether such use is of a commercial nature or is for non-profit educational purposes;
>
> (2) the nature of the copyrighted work;
>
> (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and
>
> (4) the effect of the use upon the potential market for or value of the copyrighted work.[63]

A determination of whether there has been infringement or whether a use is "fair" is thus one that requires a contextualized assessment of the use.

The rules regarding the infringement of copyright mean that not every use by another of all or a substantial part of a copyright protected work will be infringing. Whether an otherwise infringing use can be justified as fair use, however, will depend upon a range of contextual factors.

Patent law

Chokshi *et al* describe a patent as "essentially an agreement whereby the inventor of a technology discloses knowledge for the advancement of society in exchange for a limited period of exclusivity over that technology."[64] A patent provides a 20-year monopoly over an 'invention'. An invention is defined in the U.S. *Patent Act* as "any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof."[65] Patents therefore protect a type of intellectual property that is quite distinct from that protected by copyright law. The duration of patent protection is considerably shorter than the protection available under copyright law; however, the protection is also more robust. For example there is no real equivalent to the "fair use" exception to infringement in patent law. There is an "experimental use" exception in patent law, but it is interpreted narrowly.[66]

Patents are not available for things that occur in nature. For example, the discovery of a new organism is not patentable,[67] nor are mathematical formulae or principles of nature.[68] The United States Supreme Court has also recently ruled that naturally

occurring human DNA sequences are not patentable because they are products of nature.[69] The public interest is simply not served by granting monopolies to things that are discovered and not invented.

Many citizen science projects will not give rise to patentable inventions. For example, if the goal of the project is to collect data about the dispersal of particular species,[70] to transcribe old documents,[71] or to collect and analyze soil or water samples,[72] patentable inventions are highly unlikely to result. However, it is not impossible that some projects will give rise to patentable inventions – or that citizen scientists themselves might be involved in co-invention.[73] For example, if specialized equipment is used to gather or measure samples, and one or more participants assist in improving the tools or devices used, this may give rise to a patentable invention, since improvements on existing inventions can be separately patentable.[74] Further, since the functional aspects of software are patentable in appropriate circumstances, it is possible that a novel software process that is developed as part of the project infrastructure might be patentable. Some projects, particularly those in the biomedical field or molecular sciences, may also give rise to patentable inventions. For example, biotechnology research may yield patentable procedures, tools or inventions such as physical materials, chemical compounds, synthesized DNA, research tools and techniques.[75]

Unlike copyright, which arises automatically when the work is created, patent rights only come into existence once a patent application has been filed, and a lengthy examination process has been successfully completed. A patent must be applied for by the inventor(s). It is frequently the case that an invention has more than one inventor; where this occurs, all inventors must apply. In some cases – as, for example, where citizen science participants are asked to engage in activities that have inventive dimensions or that may result in an "invention" depending on the extent of the participation of particular individuals, they may be co-inventors. The threshold for co-invention is quite high, so this is not likely to be a common occurrence, but it is certainly possible in some contexts.[76]

Of course, there is no requirement to apply for a patent. An invention that is made public and for which no patent protection is sought, essentially falls into the public domain.[77] Many researchers engaged in citizen science may have no interest in patenting any fruits of their research. The desire to patent any inventions flowing from a project (or to dedicate them to the public domain) may depend on a variety of factors. These may include the policies of the institution at which the researchers are employed; the expectations of those funding the project; or the extent to which the project co-ordinators seek to commercialize any research output.[78]

Patents can only be obtained for inventions that are 'new' within the meaning of the U.S. *Patent Act*. An invention will not be considered 'new' if it has been disclosed to the public before the filing of the patent application.[79] The only exception to this rule is a short grace period in cases where the party applying for the patent is the source of the disclosure.[80] This might occur for example, where a researcher

discloses the substance of their invention in a publication or conference presentation. The very public nature of many citizen science projects may raise issues regarding disclosure of inventions, although much will depend upon the particular context. Disclosure of only fragments of information is generally not enough to destroy the novelty of an invention. Any disclosure must be of enough information to allow others to arrive at the substance of the invention.[81] At the planning stage of a citizen science project that may lead to one or more inventions, researchers should consider whether patenting is a necessary or desired outcome (as opposed to the dedication of the results to the public domain). If it is, the manner in which the project is implemented might have to limit the extent of participant access in order to share 'just enough' research data to enable collaboration without jeopardizing patentability.

In the U.S., particular rules apply to the patenting of inventions that are arrived at through public funding. This would include citizen-science projects that are funded through grants from federal agencies. The *Bayh-Dole Act of 1980*[82] permits those who have received federal funding for their research to patent their inventions and to retain ownership of those patents. However, they must follow prescribed procedures within specific time frames in order to do so. If a university chooses to patent an invention that was the product of federally-funded research, the government retains certain rights in relation to the patented invention. These rights include a royalty-free licence that permits the government to make use of the invention anywhere in the world.

In order to make these rights effective, those in receipt of federal funds must notify the government of any inventions that might be patentable; the government retains the right to step in to file patent applications if the entity in receipt of funds fails to do so. The *Bayh-Dole Act* also gives the government the ability to place restrictions on the assignment and licensing of patents obtained by non-profit organizations as a result of federal funding.

In practical terms, both public and private sector organizations who receive federal funds to support research that may lead to inventions will be bound by agreements with funding department or agency. These agreements – which will be consistent with the provisions of the *Bayh-Dole Act* – will set out the procedures to be followed, and the respective rights of the parties.

Trademark law

Trademark law protects signs or symbols that designate a particular source for products or services. The concept of "services" is very broad, and can include providing information via a computer network,[83] providing user-customized health information and health profiles,[84] and providing "education and entertainment services relating to geography, mapping, science and the environment."[85] At first glance, therefore, it may appear that trademarks are of little relevance in the citizen science context. However, it is quite possible for researchers or host institutions to seek registered trademark protection for the name and logos associated with a citizen science project. Even without registration, a project name or logo may be protected, in appropriate circumstances, as an unregistered trademark.

A sign or symbol becomes an unregistered trademark when a sufficient segment of the population recognizes it as designating the source of particular goods or services. Thus, for example, even if the institutional host of a citizen science project has not registered its name or logo, if it becomes relatively well known by that designation, then rights may accrue that could be asserted against another project or a company that uses the same or a confusingly similar name or logo in a manner that creates confusion. This may seem unlikely, yet some citizen science projects receive a great deal of media attention, and there might well be companies that seek to exploit this attention by selling T-shirts or other paraphernalia bearing the name or logo of the project; or by setting up rival websites that seek to market products to unwary visitors who think they are visiting the citizen science project.[86] For example, a high profile citizen science project relating to birds might find that its trademarks – or ones that are confusing with them – are used by a business that establishes a website through which birdfeeders and other birding equipment is offered for sale.

Project organizers may wish to consider whether it is worth registering as trademarks their projects' names and logos to avoid the possibility that they might be improperly exploited. While unregistered trademarks can be protected against exploitative uses, this protection is by no means as certain as that available for registered trademarks. For example, once registered, it is no longer necessary to establish that a trademark exists – the certificate of registration is proof of the existence of the mark. The owner of an unregistered trademark, by contrast, must be able to prove in court that their name or logo is sufficiently well-known as to constitute an unregistered trademark. Trademark registration also confers protection on a national basis; unregistered trademarks are only protected in those regions where it can be established that they have sufficient reputation. Registration also provides public notice of the existence of the trademark. Someone who is seeking to adopt their own trademark will usually conduct a search through the public database[87] of registered trademarks to see if the mark they seek to adopt – or one that may prove confusing with it – has already been registered by someone else.

Those establishing citizen science projects should also consider the possibility that the name or logo chosen for the project may infringe on the trademark rights of another. A project name or logo can become quite important in attracting participants and in establishing a sense of continuity and community. Researchers who are planning to establish citizen science projects might wish not only to take care in choosing a name and/or logo that is attractive and distinctive, but also to ensure that the chosen name or logo is not confusing with an already existing registered or unregistered trademark. Failure to do so may result in the disruption of being forced to change a project's name or logo just when it is achieving recognition.

A trademark is registered for use in relation to particular goods or services, and is protected against uses of that mark or one so similar to it that would cause confusion. This leaves open the possibility that a trademark that is identical or similar to a registered mark may be used in relation to goods or services that are quite different from those for which the mark is registered,

without infringing the trademark rights. Thus, for example, although FOLDIT is registered as a trademark for wheeled garden carts, this trademark registration likely does not pose a problem for Foldit, the citizen science project, since the goods/services are very different, and consumers are unlikely to think there is any connection between the two. The more well known a trademark is, the broader the scope of protection, since the use of a similar or identical mark, even in relation to very different goods or services becomes more likely to cause confusion, or may harm the trademark owner's goodwill in the mark in other ways.[88]

While it is fair to say the majority of citizen science projects have not sought trademark registration for their names, some have. Examples include Earthwatch,[89] eBird[90], PatientsLikeMe,[91] 23andMe,[92] iSeeChange,[93]and iNaturalist.org.[94] Projects of relatively short duration or that are purely local in nature are not likely to need registered trademarks; by contrast, those that operate in the longer term, on a more national (or international) scale, or that have potential for commercialization may be well served by this form of protection.

"Projects of relatively short duration or that are purely local in nature are not likely to need registered trademarks; by contrast, those that operate in the longer term, on a more national (or international) scale, or that have potential for commercialization may be well served by this form of protection."

Because trademark protection has only national scope, citizen science projects that call upon global participation may wish to consider whether they should register their trademarks in countries other than the United States. Whether this is worth doing will depend upon the circumstances of each case, as there are costs associated with each registration.

In addition to serving as indicators of source, trademarks can also perform a useful attribution function, and can be used to control associations. For example, if the data arising from a citizen science project is made public, the license under which it is made available might specify that any use of the data be attributed to the project either through the use of the name of the project or its logo, or both. It might also be the case that the use of the project's name or logo is expressly restricted– for example, terms of use may provide that users of the licensed materials must properly attribute the source of the data they rely upon, but cannot use the name or logo of the project in such a way as to suggest that they are affiliated with or part of the project. The terms may also provide that express permission be sought for any use of the trademarks.[95]

Once registered, a trademark is valid for 10 years.[96] This term of protection is renewable for an unlimited number of 10-year periods so long as the mark continues to be used.

Traditional knowledge

Some citizen science projects, particularly ones that are community-based may involve the collection of traditional knowledge. "Traditional knowledge" denotes a system of knowledge that reflects "a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment."[97] Traditional knowledge finds its expression in a variety of different forms. These may include: "stories, songs, folklore, proverbs, cultural values, beliefs, rituals, community laws, local language, and agricultural practices, including the development of plant species and animal breeds"[98] Traditional knowledge is not static – where it exists it is in a constant process of evolution and development. Traditional knowledge is generally understood to be oral in nature, and transmitted from one generation to the next.[99] In North America, indigenous communities (referred to in the U.S. as Native Americans) are sources of traditional knowledge.

Traditional knowledge may be incorporated into citizen science projects in a number of different ways. Because of the strong links between indigenous communities and the land, much traditional knowledge is also knowledge of the land, flora, fauna, weather conditions and other natural phenomena. This knowledge may be considered invaluable for projects oriented towards ecology and conservation.

Traditional knowledge – particularly as it relates to plants and animals – is not protected as such by domestic law in the United States.[100] Nevertheless, there is a growing international consensus that traditional knowledge deserves some measure of protection,[101] and there are ethical boundaries to its collection and use. The rights of indigenous people to receive recognition for and to maintain control over their culture and traditional knowledge flow from the basic human rights to self-determination, equality or non-discrimination, integrity, freedom, and access to justice.[102] In fact, many North American indigenous communities exercise control over research projects and set parameters for the collection and use of traditional knowledge.[103]

Thus, in the citizen science context attention should be paid not just to the ethical collection of traditional knowledge from indigenous communities (something that is addressed in research ethics protocols, or that may be a matter for negotiation with indigenous communities themselves), but also to the ethical use and dissemination of this information.[104] This may be particularly important as protecting indigenous knowledge may be overlooked in open development environments that promote universal access, universal participation and collaborative production of knowledge.[105] Thus care and attention should be paid to what information is shared, with whom, and for what purposes. Technological controls may prove useful in providing different levels of access.[106] Initiatives around the development of template licenses for traditional knowledge also seek to balance sharing with the needs and interests of indigenous communities.[107]

Confidential information or trade secrets

As noted earlier, copyright law does not protect facts. At best, it will protect the

original selection or arrangement in a compilation of facts. Yet there may be circumstances in which researchers wish to protect their research data itself. For example, privately funded research groups may wish to protect the financial value or future return of their initial investment in research and development (R&D) by keeping the research data protected.[108] In such circumstances, the law of confidential information or trade secrets may offer some benefit.[109] The protection of trade secrets may also be of use where researchers are moving towards the development of a patentable invention. Because an invention cannot be patented if it is not "new", it is extremely important for those seeking to patent their inventions to maintain confidentiality to the extent possible prior to filing the patent application.[110] Of course, while offering some benefits to those seeking to commercialize innovation, the protection of information as a trade secret or confidential information can create barriers to innovation by causing information to be withheld from the broader community of scientists.

The *Uniform Trade Secrets Act*[111] defines a trade secret as:

> information, including a formula, pattern, compilation, program, device, method, technique or process, that:
>
> (i) derives independent economic value, present or potential, from not being generally known to, and not being readily ascertainable by proper means by, other persons who can obtain economic value from its disclosure or use, and
>
> (ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.

A popular example of a trade secret is the Coca-Cola syrup recipe; only know to a few select employees at the company. *Photo Credit: Wikipedia*

The kind of "information" that can qualify as trade secrets or confidential information is construed very broadly. Certainly, research data would fall within its boundaries. Because trade secret protection furthers goals of supporting innovation and protecting against unfair competition in business, the information must have some commercial value in order to benefit from protection – and that commercial value must be linked to its remaining confidential. The "owner" of confidential information or trade secrets must take reasonable steps to secure the information. This may include entering into confidentiality agreements with employees, or with potential investors to whom the information is necessarily revealed; using appropriate security measures (for example, encryption of data); or creating physical barriers (keeping the data in a secured area either in a building or on a computer server). Trade secret protection is available for as long as the information is

kept secret; in theory, therefore, it may be perpetual. Obviously, trade secret protection will not be available to researchers who decide to make their citizen science research data publicly available.

In some cases, particularly where the research data is itself sensitive, there may be other motivations or obligations to protect the confidentiality of information. For example, in the case of research on human subjects, researchers have ethical obligations to ensure that the information gathered is secure and protected from inappropriate disclosure.[112]

"It may also be that researchers determine that some of the information gathered in citizen science research might cause harm if it is disclosed to a broad public, and may therefore wish to limit access to that information. Researchers must make their own ethical assessments of the situation, and protect information accordingly."

In these circumstances, it is not the law of trade secrets or confidential information that is most relevant. Instead, institutional ethics protocols must be complied with, and there may be privacy or security law consequences if individuals are harmed by breaches of confidentiality.

It may also be that researchers determine that some of the information gathered in citizen science research might cause harm if it is disclosed to a broad public, and may therefore wish to limit access to that information. For example, a study of the location and behaviour patterns of animal species that are also hunted as game might make those animals more vulnerable to hunters, if the information is publicly accessible. Again, while the protection of the gathered information may be important in these contexts, it is not the law of confidential information or trade secrets that is most important. Rather, researchers must make their own ethical assessments of the situation, and protect information accordingly. There are laws that provide remedies where outsiders breach technical barriers to improperly access information.[113]

PROACTIVELY ADDRESSING IP ISSUES

From the discussion above it is clear that with the exception of copyright (and, to some extent unregistered trademarks), all types of intellectual property law require some form of choice to be made before the rights come into existence. One possible response, therefore, when faced with issues of intellectual property flowing from citizen science projects is simply to do nothing. If nothing is done to keep information confidential, or to pursue the patenting of inventions, then those materials will fall into the public domain. This is a perfectly legitimate choice, and it is one that is already made by many researchers.[114] However, once such a choice is made, it is not easily undone. In the case of a patentable invention, for example, disclosure of the substance of the invention by the inventor starts a countdown; if the patent application is not filed within a year of the disclosure, the invention will become unpatentable for lack of novelty. In the case of confidential information,

the publication of the information will put an end to its confidentiality. The choices made by researchers with respect to research output will need to be consistent with the researchers' institutional obligations, with obligations to funders, and with the long term goals for the project (which may or may not include the potential for commercialization).

Copyright law creates its own particular issues because it arises automatically and without need for formalities. Unlike patent law, copyright involves no examination process to determine its legitimacy or scope. As a result, in many instances the actual subsistence of copyright or its extent cannot really be known without litigation. For example, a researcher may claim copyright in a compilation of data, even though it may not be known whether the compilation has sufficient originality in the selection or arrangement of its data. The automatic nature of copyright and its uncertainties mean that the issues it raises are best addressed up front in order to avoid later difficulties. This is so even if there is no interest in commercial exploitation of these rights. If copyright issues are not addressed up front, researchers might later find that they lack the permissions they need to publish certain content or images, or to disseminate materials via online means. The potential that third parties may have rights in contributed materials (as, for example, where a participant contributes a photograph that another person has taken, or where a participant contributes a photograph to the project but later transfers his or her copyright to a photo contest to which he or she has also submitted the photograph) may also need to be addressed.[115] Where participant contributions are made through a third party platform that acquires a license to use contributors' contributions in ways that go beyond the boundaries of the research project, this too should be made transparent to the participant.

There are multiple parties that could influence how IP rights are managed in citizen science. Prior to launching a citizen science project, researchers should examine any agreements they have with their university or research institution, government or private funding sources, and any research partners to determine how such agreements may affect the availability of the IP- protected project outputs to citizen scientists and the broader public. Furthermore, researchers should examine whether these agreements and/or any third party contents used in the research can create any potential liabilities or limit citizen scientists' ability to interact with the research project. To minimize any IP conflicts after the research, it is important that any limitations are communicated to citizen scientists and are also reflected in the project's IP policies. These issues will be discussed in greater detail in Part III.

INTELLECTUAL PROPERTY RIGHTS AND ETHICS IN CITIZEN SCIENCE

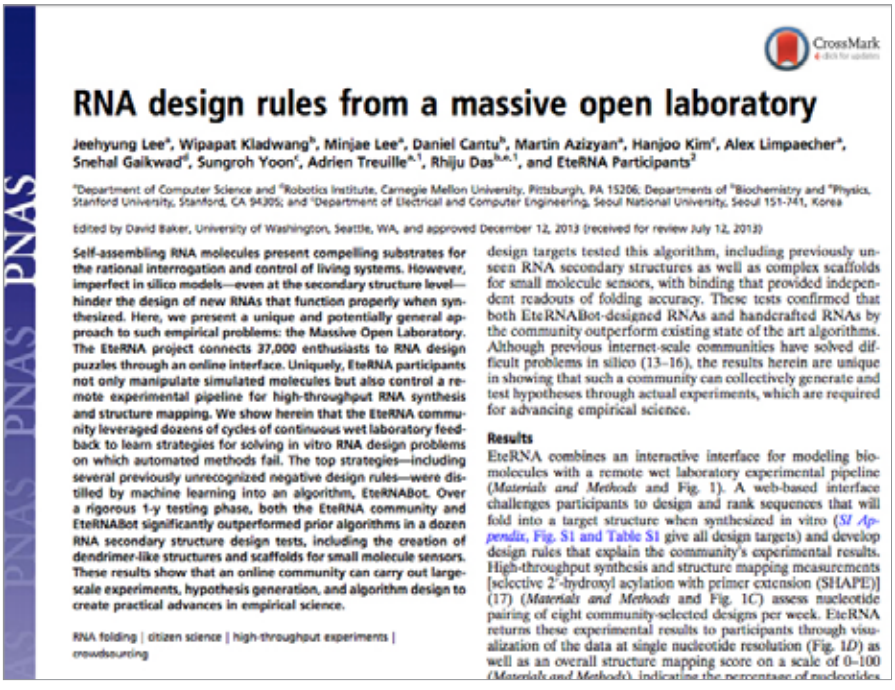
In many cases, these intellectual property issues have strong ethical dimensions. This is not surprising, since intellectual property rights and their exercise reflect a series of relationships between individuals and intangibles (for example, determining who is an 'author' or an 'inventor' of research output), and between individuals in relation to those intangibles (for example, licensing some individuals to use the work; or excluding others from access to or use of it). In addition to intellectual property laws that govern these relationships, ethical duties may also arise. Just as it is unethical for researchers to put their names on the work of others, it is unethical either to claim intellectual property rights in the work of another, or to exclude a person or persons from co-ownership of works they have co-authored or inventions they have co-invented. These ethical norms are generally well accepted (although there may be debate as to what constitutes co-authorship, for example). Other intellectual property-related norms in citizen science collaborations are less clear, and may be in a process of evolution.

There are already strong norms within science that encourage access to knowledge and informal collaboration to advance scientific knowledge for general welfare. In the citizen science context, these norms may be reflected in emerging practices regarding the recognition of contributions of participants. For example, some projects, such as Galaxy Zoo, Phylo and Foldit, have included individual participants as authors of publications, where their contribution is sufficiently noteworthy.[116] To illustrate, the project managers of Galaxy Zoo acknowledge volunteer contribution by including a hyperlink in their peer-reviewed publications which leads to a file listing the names of the volunteers in Galaxy Zoo.[117] Galaxy Zoo researchers opted for this method because it is not feasible to acknowledge all contributors directly within the publications, as the list of contributors is too long. Other projects may find ways to recognize the entire pool of contributors, as is the case with Polymath, which uses a pseudonym for publications that denotes authorship by the collective of project participants.[118]

The participatory nature of citizen science research may also give rise to particular ethical considerations regarding access to research outputs.[119] For example, subscribing to the norms of scientific research, participants in citizen science projects may

expect that they will have open access to research output that flows from the projects in which they participate.[120] This might mean an expectation that publications resulting from citizen science research will be in open access journals, or even that research dissemination will include plain language presentations of research results for project participants or the broader public. Some participants may wish to access the research data – indeed, for some community-based projects, participants may clearly expect to be able to use the data to improve their own communities. In some cases, project participants may wish that the data gathered through their efforts be shared with the broader research community so as to provide maximum research benefits.

Although dedicating inventions to the public domain may be an emerging citizen science norm,[121] there are some circumstances where a researcher or his or her institution chooses to patent one or more outputs of citizen-science supported



PNAS

RNA design rules from a massive open laboratory

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Edited by David Baker, University of Washington, Seattle, WA, and approved December 12, 2013 (received for review July 12, 2013)

Self-assembling RNA molecules present compelling substrates for the rational interrogation and control of living systems. However, imperfect in silico models—even at the secondary structure level—hinder the design of new RNAs that function properly when synthesized. Here, we present a unique and potentially general approach to such empirical problems: the Massive Open Laboratory. The EteRNA project connects 37,000 enthusiasts to RNA design puzzles through an online interface. Uniquely, EteRNA participants not only manipulate simulated molecules but also control a remote experimental pipeline for high-throughput RNA synthesis and structure mapping. We show herein that the EteRNA community leveraged dozens of cycles of continuous wet laboratory feedback to learn strategies for solving in vitro RNA design problems on which automated methods fail. The top strategies—including several previously unrecognized negative design rules—were distilled by machine learning into an algorithm, EteRNABot. Over a rigorous 1-y testing phase, both the EteRNA community and EteRNABot significantly outperformed prior algorithms in a dozen RNA secondary structure design tests, including the creation of dendrimer-like structures and scaffolds for small molecule sensors. These results show that an online community can carry out large-scale experiments, hypothesis generation, and algorithm design to create practical advances in empirical science.

RNA folding | citizen science | high-throughput experiments | crowdsourcing

design targets tested this algorithm, including previously unseen RNA secondary structures as well as complex scaffolds for small molecule sensors, with binding that provided independent readouts of folding accuracy. These tests confirmed that both EteRNABot-designed RNAs and handcrafted RNAs by the community outperform existing state of the art algorithms. Although previous internet-scale communities have solved difficult problems in silico (13–16), the results herein are unique in showing that such a community can collectively generate and test hypotheses through actual experiments, which are required for advancing empirical science.

Results

EteRNA combines an interactive interface for modeling biomolecules with a remote wet laboratory experimental pipeline (*Materials and Methods* and Fig. 1). A web-based interface challenges participants to design and rank sequences that will fold into a target structure when synthesized in vitro (*SI Appendix*, Fig. S1 and Table S1 give all design targets) and develop design rules that explain the community's experimental results. High-throughput synthesis and structure mapping measurements [selective 2′-hydroxyl acylation with primer extension (SHAPE)] (17) (*Materials and Methods* and Fig. 1C) assess nucleotide pairing of eight community-selected designs per week. EteRNA returns these experimental results to participants through visualization of the data at single nucleotide resolution (Fig. 1*D*) as well as an overall structure mapping score on a scale of 0–100 (*Materials and Methods*), indicating the percentage of nucleotides

This paper published acknowledges the final author as EteRNA Participants.
One can download a csv file with the names of the 37,526 participants.

research.[122] In such cases, participants may also have expectations regarding an equitable sharing of the royalties. Whether and to what extent this is appropriate may depend upon the nature of the project. It may be, for example, that a project that required the close co-operation of a particular community might ethically require some form of contribution back to that community. The nature of participants' contributions may also be relevant – for example, if the patented invention was derived from genetic materials contributed by participants, or if the project relied upon traditional knowledge, there may be a particular ethical obligation to share back the benefits of commercial exploitation.[123] There may even be an ethical obligation to contribute back to the participants even in projects that are not focussed on particular geographically distinct communities. Meeting these ethical obligations may be achieved in different ways, depending on the nature of the project and the nature of the invention. Providing access to individual participants or communities that might benefit directly from the invention may be one response; in some cases, it may be enough to dedicate a portion of royalties to some cause or institution that participants would logically support.

The interweaving of legal and ethical norms with respect to intellectual property and citizen science research suggests a need for forethought, planning and transparency around these issues.[124] Working out an appropriate approach for a citizen science project will require the researcher at the onset of research to discuss with his or her institution (including any Institutional Review Board), granting foundation, and other involved groups who may have IP right claims in the research to identify any ethical issues in data collection and to define the means of research dissemination and sharing. They must continue to communicate on these issues as the project progresses. Project co-ordinators can make use of the terms of use for participation in online citizen science projects, and licenses for specific project outputs to set out the principles that govern collection, use and dissemination of research data and materials. In the next section, we look at licenses and terms of use in the citizen science context.

MANAGING INTELLECTUAL PROPERTY RIGHTS IN CITIZEN SCIENCE

Clearly, intellectual property rights issues are present in citizen science research. Participants in citizen science projects may, at times, make contributions in which they have intellectual property rights or that might give rise to intellectual property rights. Researchers will also have intellectual property rights in many different things, ranging from website design and contents, to research data, research publications, and even, in some cases, inventions flowing from the project. Other stakeholders – such as researchers' institutions, funders, private-sector partners, or third-party platform providers may also have relevant IP interests. In many cases the data and other research outputs will be of interest to others who might wish to access or use these materials; this too gives rise to a need to manage intellectual property rights.

Licenses are a key means by which IP rights are managed. The most common type of license in the citizen science context is with respect to copyright subject-matter. Given the nature of the majority of citizen science research, contributions and output, this is likely to be the most important type of license. Copyright licensing is the focus of the discussion below.

It should be noted that this paper addresses intellectual property and IP licensing issues, and this is the focus of the discussion in this part. The Terms of Use for a citizen science project and/or the Contributor Agreement may address a range of other issues besides intellectual property. These may include issues such as privacy, user conduct, liability issues, and so on. We note, therefore, that the licensing of content is only one consideration. Bowser *et al* offer a discussion of some of the other issues that may be addressed in these types of documents.[125]

WHAT IS A LICENSE?

In the intellectual property context, a license is a form of permission to exercise, under specified conditions, one or more of the exclusive rights of the intellectual property rights holder. Licenses can have varying degrees of formality. Licenses may be express or implied. An implied license is one where, from the surrounding circumstances, it can be assumed that certain permissions have been given. For example, when an author posts content on a website, with no terms or conditions attached it may be implied that he or she, is giving internet users a license to reproduce that content in

their browser windows for the purpose of viewing it online. By contrast, an express license is explicit and may be oral or in writing. An oral license might simply be the statement "go ahead and make a copy of my article." A written license is one in which the terms and conditions are set down in writing. Written licenses may be formal or informal; they may be quite simple, or they may come with precise and detailed terms and conditions. For example, the Creative Commons (CC) license is a standardized license that makes it easier for people to share copyright protected works.

A license is a form of contract. While licenses are frequently used to give permissions to make use of content protected by intellectual property rights, a license can set additional terms and conditions for use. For example, permission can be given to reproduce a copyright protected work on the condition that attribution be given to the author or copyright owner in terms specified in the license. The license might also only permit non-commercial uses to be made of the work, or it may require the payment of fees or royalties. The license is thus also a vehicle to manage not just *who* may use a work, but under what conditions they may do so.

In the citizen science context, the terms of use, terms and conditions, or user agreement for a project website may contain the details of the licensing terms which describe how researchers and citizen scientists may use different IP protected resources or contributions. A licence takes effect when users expressly or implicitly agree to the "Terms and Conditions" of a project.

LICENSE DISTINGUISHED FROM TRANSFER

A license is different from a transfer of rights. A transfer results in a change of ownership of the rights. The transferee becomes the new owner of the copyright (or the portion of the copyright that has been transferred). By contrast, with a license, the original rights holder retains their rights. They are simply giving permission to another, through the license, to carry out certain acts that would otherwise be infringing.

When researchers publish their work with corporate publishers, the publishers will often ask the researcher-author to transfer the copyrights in their manuscript because having the copyrights of the scholarly journals allow corporate publishers to control access to the journals and sell subscription services. With the growing interest in open access publishing and in institutional self-archiving of works, publishers are increasingly being pressured to move away from an outright transfer of rights to more open models of licensing ranging from fully open access (e.g., under a Creative Commons license) or to a non-exclusive license with an embargo period.[126]

EXCLUSIVE V. NON-EXCLUSIVE LICENSES

A license may be exclusive or non-exclusive. An exclusive license is accorded along with the promise not to grant the same license to anyone else. For example, an author might give a publisher an exclusive license to publish their book or article. This means that they will not grant the same permission to any other publisher. A non-exclusive license is a permission

to carry out a particular act or acts – with no promise that others will not be granted the same permission. Creative Commons licenses, for example, are by definition non-exclusive licenses.

Most citizen science projects ask public participants to grant a non-exclusive license to use the participant's contributions. For example, Zooniverse asks its participants to "grant the CSA and its collaborators, permission to use your contributions however we like to further [scientific research], trusting us to do the right thing with your data. However, you give us this permission non-exclusively, meaning that you yourself still own your contribution."[127]

DURATION OF A LICENSE

The duration of a license can be one of the terms of the contract. A license may be for the full length of the term of copyright protection ("perpetual" is often used as a short form for this). It may also be for a fixed period of time, or can simply be a permission to carry out one act ("to make a copy"), the completion of which terminates the license. For example, CitizenSort asks their participants to agree that by submitting their contribution to the project, the participant grants the project a perpetual non-exclusive license to use the contribtions.[128]

IN CITIZEN SCIENCE, WHO GRANTS A LICENSE TO WHOM AND WHY?

Licenses are frequently used in citizen science as a means of managing intellectual property rights as between citizen scientists and researchers, and as between researchers and the broader community that seeks to access and use their research data or other output.

In the citizen science context, licenses are generally more practical than transfers of rights for a number of reasons. Asking citizen scientists to transfer outright the rights in their contributions to citizen science projects is rather draconian, not user-friendly, and not necessarily consistent with the values of citizen science research. For example, if a citizen scientist is asked to transfer all rights in any photograph that she uploads to a project, he or she might find this offensive, and might question why it is necessary for the project to take ownership of her rights. Moreover, it would rob the citizen scientist of the right to use or reuse the photo for other purposes, thereby increasing the citizen scientist's cost to participate in citizen science because their time, brain power and other resources they expended to take the photo cannot be distributed over multiple uses. By law, transfers of rights must also be in writing and signed by the transferor.[129] This adds a layer of legal complexity that is simply unnecessary and undesirable in the citizen science context. However, there may be circumstances in which a transfer is desired. If the project is one in which there are explicit commercialization goals, a transfer of rights will make things easier for the project owners, as it will ensure that they own and manage all of the IP that is part of the project. For example, medical or biological researchers may ask their research participants to donate or transfer any rights they have in the contributions

such as human tissue samples or other biological materials. Doing so facilitates the development of patentable inventions from the donations or their use in commercial endeavours.[130]

Agreements between citizen scientists and projects

In most cases, an express license between citizen scientists and researchers will be enough to meet the needs of the researchers to collect, use and disseminate the data and other outputs of their project. There is usually no need for the license to be exclusive. For example, if a user contributes a photograph to a project, it is enough that the researchers have a license to reproduce the photograph, to disseminate it online, to incorporate it into a database, to include it in research publications, and perhaps to authorize others to make use of it (as, for example, when it is included in a database that is to be made available to the public). There is generally no need for the researcher to be the only person with the right to use the contribution in this way. The researchers will also want to ensure that the term of the license is sufficiently long to allow them to carry out all potential uses – a perpetual, non-exclusive license to use, reproduce or disseminate the work may be most suitable in these contexts. The broad and perpetual nature of the license secures all necessary rights for the researcher. The fact that it is non-exclusive allows the contributor freedom to exercise the rights they retain as a copyright owner, including to license others to use the work.

In the absence of an express license between researchers and citizen scientists, an implied license might be found to exist. An implied license is created by the conduct of the contracting parties (i.e. by doing something instead of exchanging words). The formation of an implied license is determined based on facts and circumstances of a case. If, for example, citizen scientists have been invited to upload photographs to a research project, and they do so, it might be determined that by doing so they have given the researchers an implied license to use these photographs. However, the precise boundaries of this license would remain uncertain. For example, while the license might include the right to compile the photographs with the other data to carry out the particular research project, it might not include the right for the researchers to make the photographs available, with the other data, in an online accessible repository. It also might not include the right of researchers to use the photographs in their published research,

"An implied license is created by the conduct of the contracting parties (i.e., by doing something instead of exchanging words). If, for example, citizen scientists have been invited to upload photographs to a research project, and they do so, it might be determined that by doing so they have given the researchers an implied license to use these photographs. However, the precise boundaries of this license would remain uncertain."

and so on. Implied licenses create uncertainty as to their scope and boundaries, and uncertainty can become problematic, particularly as new opportunities arise to make use of or to share and disseminate the research data. For this reason, the terms and conditions of a project may list possible uses of user contributions (e.g. distribute, sell, translate, and so on) along with a statement notifying users that agreement to the terms of the license will be implied from the contributor's use of the website. This type of license is known as a browse-wrap license. Express licenses offer greater certainty and clarity for all parties, and can be worded so as to permit a broad range of uses.

The terms of any licence may be affected by researchers' other commitments and obligations with respect to intellectual property. Licences are not created or chosen in a legal vacuum. Researchers should be attentive to what their funders or institutions require of them with respect to IP rights. They should also take note of the IP consequences of the use of third-party platforms (such as Facebook, Google Docs, Open Street Map, and so on). The terms of any user agreement must be consistent with the researchers' other legal obligations, and should make transparent to participants how IP rights in any project output will be managed. Researchers should also explicitly inform participants of any other terms of use (such as those for a third-party platform) that may affect their rights.

Agreements between projects and user community

Researchers may also make their project data available to a broader user community. They may provide full public access to the data, or some other more limited form of access. They may be prepared to share their data with other researchers and they may choose to place it online. In these circumstances, where others may browse, download and reuse research data, some form of license can be used in order to set the boundaries for reuse of the data or other research-related materials. Each citizen science project has different data policies and those seeking to use the data must carefully examine a project's legal policies or contact the project managers directly to determine the availability and the scope of third party data use in order to avoid copyright infringement. For example, the Public Library of Science (PLOS) provides open access journals and open access archives or repositories, which are made available to the public under the Creative Commons license. iNaturalist and Foldit also make their user data available under the CC license.

WHAT FACTORS MAY BE RELEVANT IN DRAFTING/ CHOOSING LICENSE?

Between researchers and citizen scientists

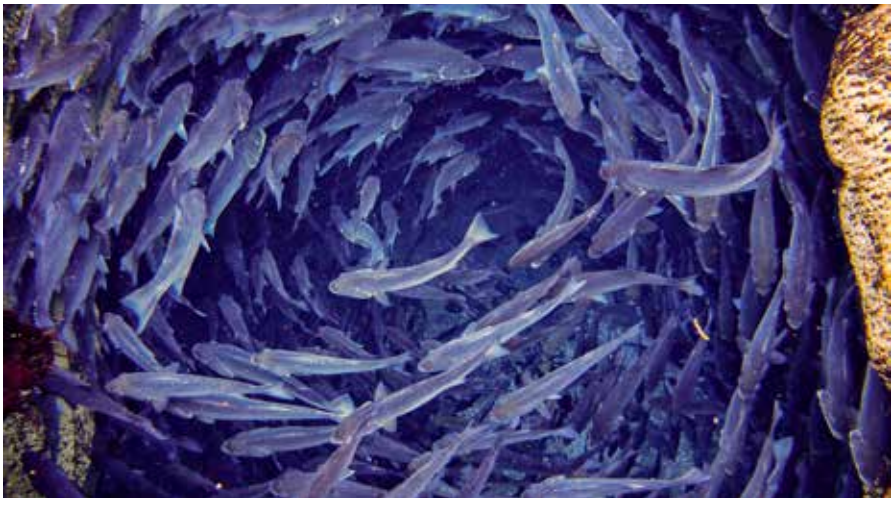
A key factor in choosing to provide a license for the intellectual property contributions of citizen scientists is, of course, whether there are likely to be any such contributions. In this respect, the typology[131] referred to earlier may provide some guidance. Some types of projects simply do not involve contributions of intellectual property. For example, in projects like NatureWatch where users are asked to submit their observations by filling out an online form composed of dropdown lists,

check boxes, dates, and small text boxes for inputting digits or short comments, such simple data submission by a citizen scientist will not attract IP protection because users are providing only facts in the public domain. Some projects on the other hand – for example, ones which ask users to contribute photographs, or to provide blog posts, written comments, implementation of ideas, new research methods, and so on – can raise copyright or patent issues which should be addressed in a license.

Between researchers and users of research data and other outputs

A variety of different factors may be relevant in drafting or choosing a licensing scheme for project data and other outputs. For example, some or all of the license terms may be dictated by external constraints on the researcher, such as those which arise from the researcher's pre-existing employment and/or funding agreements. The researcher's home institution or funders may require the research data to be treated in particular ways. For example, it has become a standard policy in the US for universities to mandate their researchers to use Material Transfer Agreements when they share research tools and materials with other scientists who belong to a different research institution. In the U.S., a recent policy memorandum from the Executive Office of the President directed departments and agencies that fund scientific research to develop plans to make published research results freely available to the public.[132] Private sector funders or industry research partners may also place constraints on whether or to what extent the data is shared with the public. Public funding agencies may also have rules mandating open access publication of research results.

In the case of community-based citizen science research, there may be an implicit or explicit understanding with the community



A photograph shared with the project Encyclopedia of Life (EOL). Scientists and volunteers must agree on a terms of use that allow for re-use of data such as photographs. ***Photo Credit: Phil's 1stPix/www.flickr.com***

that any research results will be shared back with the community, with other researchers, and/or with the public at large. It is also worth considering whether there is an emerging norm around the open access sharing of data and other research outputs that flow from citizen science. The very broad diversity of citizen science research makes it difficult to generalize, but researchers should be sensitive to the expectations of their community of citizen science participants. A researcher who is planning a citizen science project may find it useful to observe the practices of similar citizen science projects (such as projects in the same field of research or similar research design) and the expectations of the participants in those communities.

TERMS OF USE AND LICENSES DISTINGUISHED

Many citizen science projects use a type of contract called "terms of use" to govern their relationships with participants. These terms of use are usually incorporated into a project website, and may include IP license terms, along with other terms and conditions. Thus, IP licensing may be addressed as part of a longer agreement that citizen science participants must accept as a condition of participation. Other, non-IP clauses in a "terms of use" agreement may include terms which address appropriate behaviour on the site, how personal information will be protected (or shared), limitations on liability, the minimum age for participation, and so on.

Some sites may be organized such that there are a number of different policies each with a separate link or web page (for example, terms of use, privacy policy, legal liabilities and disclaimers, and IP policy). In some cases, there may be IP-related provisions in more than one document. Further, since IP issues are relevant both to citizen scientist participation and to the broader use of the material on the site, documents labeled as a license or IP policy may relate only to broader public use, with participant-related provisions being located in the terms of use. Information for those making contributions to the project and those seeking to use project data or outputs should be clearly labelled as such and easily accessible.[133] It may be good practice to place all legal policies on a single web page accessible from a link that is placed prominently on the project website such as in the footer that is displayed on every page of the website.

The types of issues addressed in terms of use may be quite important, and may relate to legal obligations and potential liabilities of the researchers or their institutions. As a result, some degree of formality may be required. Nevertheless, a high degree of complexity or legalese is not always required to articulate the IP rights of citizen scientists and the broader public's rights to use materials. This is discussed further below.

CONTRIBUTOR LICENSES

Intellectual property licenses between citizen science participants and the project to which they contribute may be quite simple or very complicated, depending upon the nature of the participants' contributions to the project. In projects where the participant does not share any IP protected content, it is not necessary to address IP issues. For example, as mentioned above, where citizen scientists only contribute data through electronic forms (e.g. fillable forms or webforms) provided by the proj-

ect there is no contribution of protected IP since facts are not protected under copyright law. However, the project organizers may still decide to include a clause, in the terms of use, specifying that the contributor provides a broad non-exclusive, worldwide, royalty-free license to the project to use and disseminate the contributed content simply as a matter of precaution. Another example is where a single license is used as a template for multiple projects. Although not every project on Zooniverse requires citizen scientists to grant a non-exclusive license for their contributions, Zooniverse as a platform for multiple citizen science projects has a user agreement that is applicable to all Zooniverse projects, which states that "if you contribute to the Zooniverse, you grant the CSA and its collaborators, permission to use your contributions however we like to further this goal, trusting us to do the right thing with your data. However, you give us this permission non-exclusively, meaning that you yourself still own your contribution."[134] The Zooniverse user agreement also states that researchers seek broad permissions from citizen scientists "because the legal environment can change and we need to be able to respond without obtaining permission from every single contributor."[135] In cases where participant contributions are likely to be protected by IP rights (uploaded original photographs, blog posts, written descriptions) then the terms under which this content is contributed should be specifically addressed.

In many cases citizen science projects have goals and objectives that do not include commercialization. However, some projects have explicit commercial dimensions, and others may have latent potential for commercialization. Where commercialization is an actual or potential goal, it is even more important to address IP rights in user contributions. This is in part because failure to do so may jeopardize or render more difficult the commercialization of the project. It would be difficult to obtain necessary permissions from each contributor after the fact when commercialization becomes a possibility. Investors may also be unwilling to commit to a project where there is uncertainty around IP rights. It is also important to avoid after-the fact licensing because citizen scientists may react poorly to changes in how their contributions will be used or licensed.[136]

"Where commercialization is an actual or potential goal, it is even more important to address IP rights in user contributions. This is part because failure to do so may jeopardize or render more difficult the commercialization of this project. It would be difficult to obtain necessary permissions from each contributor after the fact when commercialization becomes a possibility."

A number of different license terms may be used to address participant contributions to a project. Table II below offers some examples. Whether any or all of these terms are appropriate to a particular project will depend upon the surrounding circumstances.

TABLE II: Examples of Contributor IP Issues addressed in some Citizen Science Licenses

Clause Type	Purpose	Examples
License of rights in all contributions to the project (may identify types of contributions, i.e. uploaded materials, blog posts, chat comments, etc.)	To ensure researchers have all necessary rights to use the content provided by citizen scientists	Users grant perpetual, non-exclusive, irrevocable, royalty-free, sub-licensable permission to the project without limitation to make use of their contributions for the goal of progressing science (e.g. Citizen Sort, Nature's Notebook, NASA be a Martian) Also see Table III
Explanation of how user contributions may be shared, used or disseminated	To provide notice of downstream uses of user contributions	CS contributions will be licensed under a CC license (e.g. iNaturalist, Foldit, Experimental Tribe) Database and website will be openly available to public (e.g. Nature's Notebook)
Researchers hold proprietary rights in the project resources such as data, tools, and software	For researchers to clearly assert their ownership of materials that are made accessible or offered on the project website	Users may not use any services or software that is made available for download other than for the research project, or for personal and non-commercial use. They will remain the exclusive property of the project. (e.g. NASA be a Martian, Calflora)
Waiver of moral rights in contributions	To protect researchers against recourse by participants for violation of moral rights	Participants waive all moral rights in their contributions (e.g. Citizen Sort, Zooniverse)
Attribution	To inform contributors as to whether and how their contributions will be attributed to them	User names may be used when the project publicly thanks contributors (e.g. Zooniverse)

Contributors authorize the project to sue on their behalf for any violation of the IP rights in their contributions	Enables project to sue on behalf of all contributors where a third party infringes on IP rights in database or other project IP	All participants must authorize the project manager to sue on behalf of the project for any violations of the Terms that prohibit third party appropriation of research results without contributing back to the project (e.g. Open Source Drug Discovery)
Contributor indemnifies project against any law suits relating to IP rights in contributions	Protects project against third party law suits in cases where contributors are submitting content in which they do not hold the IP rights (Note that some indemnification clauses may be broader than for just IP liability)	Users must indemnify the project and its affiliates from and against any and all liability and costs incurred by the project from claims arising from the user's breach of the user agreement (e.g. Eye wire, NASA Be a Martian, Citizen Sort, Mapping for Change, iNaturalist, Calflora)
Decision to no longer participate (or to terminate account) does not terminate license to use IP, disclaimers, indemnification, etc.	Protects project by preserving IP license and other relevant provisions in instances where participants cease their participation in the project	Users can remove their contribution but the removal does not terminate the license granted prior to the removal (e.g. NASA be a Martian, Nature's Notebook)
Contributors will not contribute material in which third party has copyright	Makes contributors aware that they must not upload photographs or other content in which they have no rights	Users must not contribute or post any material they do not own (e.g. Zooniverse, Eyewire, Nature's Notebook) If you submit an image, each person depicted in the image must give consent to use the image (e.g. NASA be a Martian)

TABLE III: Simple v. complex – some examples

Goal of clause	Example of simple wording	Example of more complex wording
To obtain a license from users for use of any IP contributed	The major goal for this project is for the analyzed data to be available to the researchers for use, modification and redistribution in order to further scientific research. Therefore, if you contribute to the Zooniverse, you grant the CSA and its collaborators, permission to use your contributions however we like to further this goal, trusting us to do the right thing with your data. However, you give us this permission non-exclusively, meaning that you yourself still own your contribution. **(Zooniverse)** We ask you to grant us these broad permissions, because they allow us to change the legal details by which we keep the data available; this is important because the legal environment can change and we need to be able to respond without obtaining permission from every single contributor. **(Zooiniverse)**	By submitting Content to iNaturalist for inclusion on your Website, you grant iNaturalist a world-wide, royalty-free, and non-exclusive license to reproduce, modify, adapt and publish the Content solely for the purpose of displaying, distributing and promoting your observations and journal. **(iNaturalist)** If you are a member, you (or the author) owns the copyright in the messages, images, and other content you post in the Member Area, but by posting such content within User Submissions to the Member Area you grant PatientsLikeMe and our affiliates the right to use, copy, display, perform, distribute, translate, edit, and create derivative works of your User Submissions, subject to the terms of the Privacy Policy. **(Patients Like Me)** You grant to the operator of the Site, the sponsor, our affiliates, and our partners a worldwide,irrevocable, royalty-free,nonexclusivelicenseto use, reproduce, create derivative works of, distribute, publicly perform, publicly display, transfer, transmit, distribute, and publishYour Content and subsequent versions of Your Content for the purposes of: (1) displaying Your Content on the Site; (2) distributing Your Content, either electronically or via other media, to users seeking to download or otherwise acquire it; and/or (3) storing Your Content in a database accessible by various end users. This license shall apply to the distribution and storage of Your Content in any form, medium, or technology now known or developed later. **(Nature's Notebook)** You may provide Us with any data or materials that You own as long as no third party has any ownership rights in the material provided. Upon provision to Us, You are also providing NEON, all Site visitors and the U.S. Federal government with a nonexclusive, non-transferable, irrevocable, royalty-free, world-wide license to exercise, or have exercised, all the exclusive rights provided by Your copyright in the provided data or materials (but not for sale to the general public). **(Project Budburst)**

To ensure that users do not contribute materials in which others own intellectual property rights	Finally, you must not contribute data to *Citizen Sort* that you do not own. For example, do not copy information from published journal articles. If people do this, it can cause major legal headaches for us. **(Citizen Sort)**	Any material, including but not limited to registration information, data, text, graphics, models, displays, calculations, reports, or commentaries that you upload, post, transmit, e-mail, or otherwise make available on the Site is referred to as "Your Content." You are solely responsible for Your Content. You represent and agree that you own all intellectual property rights in Your Content. **(Nature's Notebook)**

There is considerable variation across licenses in terms of readability. Some citizen science projects opt for a very accessible style of license – more consistent with the creative commons model. Such licenses may contain relatively few terms, expressed in straightforward language, and sometimes using examples to illustrate the meaning of a given clause. For projects with little or no potential for (or interest in) commercialization, a more straightforward license is typically used. Where a project has the potential for commercialization, or explicitly aims to commercialize the project output, a more stringent, legalistic license might be chosen. The value of clarity and simplicity is evident. By the very nature of the enterprise, citizen scientists are not likely to be legally sophisticated users, or ones who engage regularly with IP licenses in the course of their daily activities. If they are being asked to contribute content to a research project, there is an ethical duty on researchers to explain in clear and straightforward terms how that content will be used, and where the parties stand with respect to ownership and use of the materials.

Parsing a license term

The terms of an IP license may be quite densely packed – especially those that deal with the core licensing of the rights at issue. In the extract below, taken from the Nature's Notebook Terms of Use, we underline key terms or concepts, and parse them, with explanations provided in numbered notes. This is intended to give some sense of what is sought to be achieved by the different elements of the clause:

You grant to the operator of the Site, the sponsor, our affiliates, and our partners (A) a worldwide(B), irrevocable(C), royalty-free(D), nonexclusive(E) license(F) to use, reproduce, create derivative works of, distribute, publicly perform, publicly display, transfer, transmit, distribute, and publish(G) Your Content and subsequent versions of Your Content for the purposes of: (1) displaying Your Content on the Site; (2) distributing Your Content, either electronically or via other media, to users seeking to download or otherwise acquire it; and/or (3) storing Your Content in a database accessible by various end users.(H) This license shall apply to the distribution and storage of Your Content in any form, medium, or technology now known or developed later. (I) (from Nature's Notebook Terms of Use)

A. It is important to consider to whom the licence is being granted. This wording is particularly inclusive.

B. The license will permit use of the contributions around the world, reflecting the global nature of internet-based citizen science activities.

C. The license is irrevocable. This means that once the participant has provided the content, they cannot withdraw their permission to the researchers to use the licensed material. This protects researchers against having their project gutted by participants who later decide to withdraw their contributions from the project.

D. This means that the participant will not receive royalties to be paid in exchange for the use of the licensed content.

E. A nonexclusive licence grants permission to do the licensed acts but does not promise that the same permission will not be given to others.

F. This is a license and not a transfer of rights. The researchers are granted permission to use the content, the contributors retain ownership of the underlying intellectual property rights (if they exist) in the contributions.

G. This part lists the acts that are being licensed. They are set out in broad and inclusive terms – this language provides extensive rights to use, reproduce, disseminate and modify the contributed materials.

H. This language indicates the purposes for which the license is granted. Stating purposes can limit the scope of the license. For example, the license might specifically limit the purposes to ones directly related to goals of the project. The ones in this example are somewhat more open-ended. Note that the stated purposes ensure that researchers will have the authority to display, disseminate and incorporate the data within a database.

I. This ensures that the license is not restricted so as to limit the grant of permission to use of the content in particular file formats or in relation to specific technologies that might later become obsolete. (For example, a license that permitted researchers to store the licensed works on CD ROMs would already be posing problems for the researchers).

Caveats and disclaimers

In cases where users are contributing content that may be protected by copyright, issues may arise if those users contribute content in which other persons have rights (for example, they might upload photographs taken by somebody else, or they might upload extracts from published materials written by other people). It is relatively common for user agreements to address this issue, although they may do it in different ways. In some cases, for example, the user agreement asks people not to do this (e.g. Zooniverse). Some user agreements warn users that if they receive complaints regarding copyright infringement or the circumvention of digital rights management with respect to content that the user has uploaded those contents may be removed and all links to the infringing contents will be disabled (e.g. iNaturalist). Failure to abide by the terms and conditions of the project can also lead to denial

of access to the site or to the termination of a user's account without notice under some policies (e.g. PatientsLikeMe, Project BudBurst, Foldit). In some instances, the user agreement will specifically indicate that the user will indemnify the project if the project is sued in relation to the citizen scientist's contributions (including materials that infringe intellectual property rights like, Eyewire, CitizenSort, and PatientsLikeMe).

Moral rights waiver

Because moral rights are not generally applicable to copyright-protected works in the United States, licenses drafted for use in the U.S. rarely require a waiver of moral rights. However, as citizen science is often a borderless enterprise, those projects that operate on a global basis (or at least on a multi-national basis) may wish to include in their license a waiver of moral rights. Moral rights provide creators of copyright protected works with at least two core rights (some countries protect considerably more than this). These core rights are the right to be associated with the work as author and the right to protect the work against mutilation or modification.[137] Moral rights may be asserted even after the author or creator of a work has transferred their copyright to someone else. Moral rights cannot be licensed or transferred, but they can be waived. A waiver simply means that the rights holder agrees not to assert those rights against the other party to the agreement.

License Scope

Typically a project will ask users for a non-exclusive, royalty-free, world-wide license with respect to their contributions. With a license, the contributor retains the copyright. A non-exclusive license means that the contributor is free to use the materials herself, or to license others to use them. A royalty-free license simply means that the contributor will not require payment of any royalties for the use of their contributed materials. Licenses are typically worldwide – this is in keeping with the international nature of much scientific research and research dissemination – it is also consistent with placing materials on a website that can be accessed from anywhere in the world.

Some licenses specify the catalogue of rights that are being licensed (e.g.: to use, reproduce, create derivative works, distribute, publicly perform, publicly display, transfer, transmit, distribute, and publish the work). This is in contrast to the much simpler terminology used in the Zooniverse license, which seeks "permission to use your contributions however we like." However, the Zooniverse license still specifically addresses the anticipated uses of the data. In other words, it communicates to participants how the researchers plan to use the contributed materials. This can be useful in providing greater transparency and accountability to participants, and can serve broader goals of furthering participants' understanding of the nature of the research in which they are participating. In some cases, however, researchers may be uncertain of the potential for future uses (including commercialization) for their research or their site; in such cases they may wish to draft a license that is as inclusive as possible regarding the rights licensed and that is more open-ended about the purposes for which materials will be used.

THIRD PARTY PLATFORMS OR CONTENT

Some projects make use of third party platforms to host all or part of their project. For example, projects that involve mapping data may use a mapping platform such as Google Earth or Open Street Map (OSM). Some projects are hosted at least in part on a platform such as Facebook (e.g. Eyewire). Others may use social media platforms such as Facebook, WordPress or Twitter for all or part of the social interactions between contributors and researchers (e.g. What's the Score? uses WordPress for the project's blog). These platforms will all have their own terms and conditions governing use, and, in particular, may have clauses that govern IP rights in relation to material uploaded to or communicated through the platform. This can add another layer of intellectual property licensing. Some platforms such as OSM obtain only a non-exclusive, royalty-free license from contributors to use the material they contribute, and, in turn, provide the contents of their site for use by the public under an open data license. Facebook requires a "non-exclusive, transferable, sub-licensable, royalty-free, worldwide license to use any IP content that you post on or in connection with Facebook". Researchers should be aware of host platform terms and should consider whether or how they might impact on their own plans to use the research materials. They should also be aware that users will be required to accede to these terms as a condition of participation in that part of their project and should perhaps alert contributors to this fact. Similarly, when a citizen science project incorporates a third party database like in Galaxy Zoo (Sloan Digital Sky Survey image archive), notice should be given of the terms and conditions relating to the third party database so as to prevent infringing uses of the database.

END-USER LICENSES

An end-user license governs the relationship between the licensor (in this case a citizen science project) and someone who uses the website or who uses content made available by the project (such as publications, software or data). From an IP perspective, this is different from the agreement between the participant and the research project, since the end-user license governs how the broad public may access and use IP contents hosted on the project websites, whereas the contribution license governs how the researchers may use the contributions of citizen scientists. However, many projects roll both sets of terms into the same document – as part of the general terms of use for the site.

Many citizen scientists will be both contributors and end users – they may be contributing content protected by IP rights to the project, but they are also using the project website. Some may even be planning to use data from the site or to download any publications resulting from the citizen science research. Because participation takes place through the site, the participant may be required to accept both the end-user license terms and the participants' terms of use – thus explaining why the two are often combined together in the general terms of use for the site. It does, however, contribute to the length and complexity of many of the terms of use on citizen science websites – the terms are adapted to govern a whole range of conduct and activity that go beyond simple participa-

tion in the project or intellectual property rights. Additional terms of use may include provisions regarding privacy, appropriate conduct on the site, the project's liability (or more importantly the lack thereof) for any use of materials obtained from the site, and so on.

Whether they are part of the general terms of use or separate from them, end-user intellectual property licenses set out what types of uses may be made of website contents. Users may be allowed to download and reuse materials found on the site, although the license may also set terms and conditions for such use (for example, requiring that any reuse be non-commercial, or that it be given proper attribution).[138]

As with agreements with contributors, end-user IP licenses for citizen science projects should take into account the obligations of the researchers towards their institutions, research partners and their funders. It may be, for example, that the terms of any funding arrangement, or an institutional policy, require that research data be made open. If so, the terms of the agreement should reflect this.

An end user license sets the terms and conditions for use of all of the material made available through the project. This may include contributions of citizen scientists. Thus, the license with contributors should be on terms that will enable the kind of use permitted in the end-user agreement. For example, if contributors have been promised that their photographs will not be used without attribution and the photographs are available from the website, then the requirement to give appropriate attribution should be present in the end-user license.

Where some of the contents of the site are made available under separate terms and conditions, this should be specified. For example, if peer-reviewed open access publications are made available, and these publications have been published under a particular open license used by the journal, it should be specified that this type of content is made available subject to the specific license conditions attached to the article.

The website may also contain other project IP, such as trademarks. These may be registered or unregistered trademarks. In general, trademark use may be required under the terms and conditions in some circumstances (for example, in giving attribution for any project materials that are used by a downstream user). It may also be prohibited in others. For example, the researchers may not want their project to be associated with some downstream uses, or, more particularly, may not want to have end-users create the impression that their own works, publications, or projects are affiliated with or endorsed by the project. Restrictions placed on the use of project trademarks may include a requirement to seek permission before making any such use.

An end user license may also include caveats and disclaimers relating to the content made available from the site. For example, a citizen science project that asks users to upload photographs would not wish to be held liable if a contributor uploaded a photograph in which she did not have rights, and that photograph was in turn used by an end-user who is later sued for copyright infringement by the owner of the rights in the photograph. For example, the policy that applies to the NASA Be a Martian project provides: "that Caltech

makes no representations or warranties with respect to ownership of copyrights in the images, and does not represent others who may claim to be authors or owners of copyright of any of the images."[139]

Open template licenses – choosing the right license?

It is not always necessary to draft IP terms for an end-user license from scratch. For example, it may be much easier and more convenient for researchers to adapt a template license to suit their needs. Many different template licenses have been developed in order to facilitate a broader sharing of works. It is also possible to look to licenses used by other projects. However, it should be noted that licenses themselves may be protected by copyright. If researchers wish to substantially copy the license of another project, they should not do so without permission. Some licenses, such as the Zooniverse license are made to be adaptable to the broad range of projects hosted on the Zooniverse platform.

Creative Commons (CC) licenses are among the more well-known of the open license templates. By default, a CC license allows distribution of copyright protected works for non-commercial use without any modification. Variations on the main license set different terms and conditions. A CC license has four main conditions that relate to how a copyright work may be used: attribution, share-alike, non-commercial, and no derivative works. These conditions may be mixed and matched by a copyright holder to define how the copyright holder's work may be distributed worldwide.

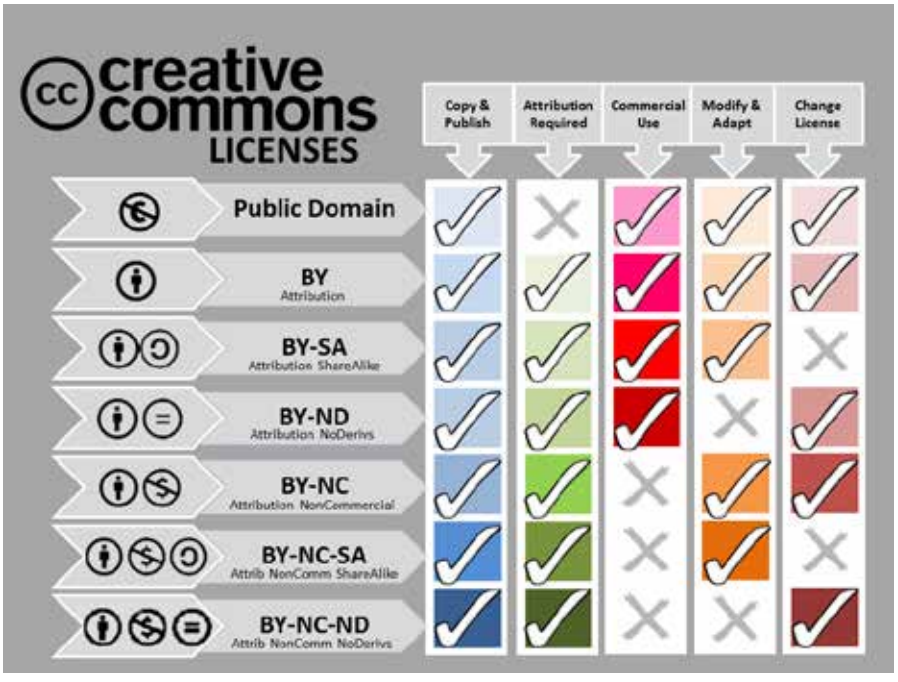
Table IV provides a sample of some of the templates available. Choosing a template license as an end-user IP license reduces the burden on researchers. It also helps many end-users as such licenses are increasingly well-known and understood. The use of a well-known template can also facilitate legal interoperability. In other words, it may make it easier for users to use the licensed content in combination with other content made available under the same or a compatible license.

ENFORCEABILITY OF LICENSES

A license is a form of contract (as are terms of use), and a contract reflects the terms of an agreement between two or more parties. Because so much commercial and other forms of activity are carried out online, some basic principles have emerged around the use of licenses and terms of use in the online environment and the circumstances in which they will be enforceable.

The difference between a browse-wrap and a click-wrap contract

Most citizen science project websites use click-wrap or browse-wrap contracts to bind public participants to its terms and conditions of use. These non-negotiable contracts are used all over the Internet especially on e-commerce sites and for software licensing. A click-wrap agreement is formed when the user clicks or checks a box usually labelled "I agree" or "I agree to the terms and conditions". Many websites will include this step in user registration or before granting access to their contents and services. A browse-wrap agreement, on the other hand, does not require a user to do anything. A website using browse-wrap contracts typically displays the



How to attribute creative commons.
Photo Credit: Foter (http://wiki.ubc.ca/File:CC_License_Requirements.png)

link to its terms and conditions at the bottom of the page and the user becomes bound by the terms simply by using the website. Click-wrap or browse-wrap agreements are unilateral or take-it-or-leave-it type of contracts, which means that the user must accept the terms and conditions in order to interact with a website.

Enforceability

Click-wrap or browse-wrap user agreements are generally enforceable in the US. However, the law is still in a state of uncertainty, thus, the outcome of a dispute may depend on its fact pattern. US courts usually uphold click-wrap contracts when the user was given a reasonable notice about the existence of the terms and conditions (T&Cs) and they were given an opportunity to review the T&Cs.[140] The enforceability of a browse-wrap contract is more contentious because the user does not perform any action to explicitly accept the T&Cs. As with click-wrap agreements, it is important to give reasonable notice of the terms by prominently displaying the T&Cs on the website.[141] A court may also consider fairness and the clarity of the T&Cs to determine a browse-wrap contract's validity.[142]

Table IV: Examples of Template Open Licenses

Open Licensing Body	Licensed material	Available Licenses
Creative Commons	Copyright works generally	Attribution (CC BY) Attribution-NoDerivs (CC BY-ND) Attribution-NonCommercial-ShareAlike (CC BY-NC-SA) Attribution-ShareAlike (CC BY-SA) Attribution-NonCommercial (CC BY-NC) Attribution-NonCommerical-NoDerivs (CC BY-NC-ND) Public Domain Dedication (CC0)
Open Data Commons	Data and Databases	Public Domain Dedication and License (PDDL) Attribution License (ODC-BY) Open Data Base License (ODC-ODbL) (Attribution and ShareAlike)
Open Source Licenses (approves open licenses created by others according to its standards)	Software	Approved Licenses are listed here: http://opensource.org/licenses
Free Software Foundation	Software	GNU General Public License
Apache Software Foundation	Software	Apache License
UK National Archives	Public Sector Information	Open Government License For Public Sector Information
Mukurtu	Traditional Knowledge	TK Commercial (TK C) TK Outreach (TK O) TK Non-Commercial (TK NC) TK Attribution (TK A)

BEST PRACTICES FOR IP MANAGEMENT IN CITIZEN SCIENCE PROJECTS

As seen in the discussion above, issues around IP rights can arise within the many different relationships that are formed around citizen science projects. Researchers and their institutions constitute one set of relationships; researchers and their funders are another. In these cases the institutions and/or funders typically outline their expectations regarding the researchers' IP obligations in contracts of employment or in institutional polices that are incorporated by reference into those contracts, or in funding agreements. Similarly, citizen science researchers who are part of a larger research collaboration or a multi-institutional consortium of research may need to follow the IP policies enforced or encouraged by the research consortium. The relationship between the researcher and the citizen scientists who participate in a project is a crucial one; not only does there need to be management of the intellectual property rights that might exist in relation to user contributions, there should also be management of the expectations of users with respect to their rights to access and use any project output. The relationship between users of the output of citizen science research – whether it is the data, research publications or other such materials – and researchers is also important. Researchers must give some thought to how the research output will be shared, with whom and under what conditions. All of these relationships are intertwined: the terms of the agreement between a researcher and his or her funder, for example, may have an impact on who can access the results of the research and on what conditions. Interwoven with these primary relationships are a series of other possible relationships, including between researchers and any third party platform used to host the research, or the providers of research materials such as satellite or drone images.

The IP license and/or end user agreement are important tools for managing IP rights in citizen science. As seen in the previous section, these can be highly formal or quite informal, depending upon the circumstances and goals of each project. They may be custom-made or derived from existing templates. There are a growing number of available examples and templates upon which to draw. It is a best practice in citizen science to use an IP license for contributors as well as for end users.

In this Part we outline best practices for IP management in citizen science projects.[143]

There may certainly be circumstances in which researchers will wish to seek legal advice, particularly if commercialization is a potential or actual goal in relation to the research. This discussion is not intended to serve as legal advice. Instead, this Part offers an overview of important considerations in approaching the management of IP issues, from both the perspective of the researcher and of the citizen scientist. We offer a detailed table for researchers involved in the design and implementation of citizen science projects. This is followed by an IP checklist for citizen science participants.

In outlining these best practices our goal is not to unduly bog down interesting and innovative research projects, or to make their design overly-complicated. The main focus of this exercise, from the researcher's point of view, should be to ensure that they will be able to do what they both need and wish to do with the research data and other project outputs; to ensure that the needs and expectations of participants and/or participant communities with respect to access to and use of project outputs are considered and met; and to ensure that research data and output can be controlled, shared or disseminated in the ways that best suit the researchers' objectives. Thinking about the IP issues in citizen science in advance may also be important to sustain citizen scientists' interests because it allows researchers to plan IP policies that do not diverge too much from the expectations of the citizen scientists whose motivation for participation may come from social and/or innate reasons such as improving social welfare and facilitating scientific progress.[144] On one level, it is an exercise in awareness of the various IP rights that may arise in relation to any research project, made more complicated by the number of participants, the diverse nature of their contributions, and the enormous potential for sharing and for derivative uses of the project outputs.

Table V below offers an overview of best practices aimed at researchers who are creating or implementing citizen science research projects. We have divided considerations into four broad categories. The first is project design and planning. This is the initial stage where the project has yet to be launched. At this stage it is important to think about the researchers' own IP needs and constraints, how they would like to ensure access to and use of project outputs, and how they will protect or manage any IP generated by the project. It is also a stage at which it is important to consider how users will contribute to the project. As noted earlier, for example, data entered onto electronic forms is much less likely to give rise to IP rights that rest with

the contributor than data submitted in the form of written observations, photographs or videos.

The second main consideration relates to the use of third party tools or platforms that a researcher may decide to incorporate into the project. In many cases, there will be IP rights that relate to these tools and platforms, along with agreements that constrain how they are to be used. A third consideration is how to deal with participant contributions to the project. Not only is it important to set terms and conditions for contribution and use of this material, it is important to pay attention to how these terms and conditions are framed and how participants are given effective notice. This is not just a legal consideration; it is an ethical one, as this is part of how the relationship between researchers and participants is defined. The final consideration relates to research dissemination and commercialization, and those things that should be taken into account to ensure that any plans for dissemination and/or commercialization can be fully realized.

Table V is followed by a check-list aimed at those who engaged as participants in citizen science projects. In many, if not most, cases participants are not motivated by thoughts of gain, nor are they necessarily interested in exercising any particular level of control over any IP rights in their contributions. Nevertheless, IP issues are still important. Some participants may be happy to share their photographs or other contributions with the project, but want to retain the right to use these materials themselves for other purposes. In some cases, participants are content to share with researchers, but may be concerned about broader re-use or sharing without some say in how this will take place. This may be the case, for example, where what is shared is traditional knowledge, or has some level of personal significance. In some cases it will be important to participants to know not only on what terms and conditions they share their contributions, but what their rights will be to access or use any project output. They may also be interested in knowing whether the project data or other outputs will be kept confidential, shared with other researchers, or shared more broadly with anyone with an interest in the topic.

TABLE V: Best Practices

Tasks	Considerations	Examples
Project Design or Planning	*Identify pre-existing IP requirements or restrictions*	Identify possible IP claimants in the research output by reviewing IP policies of your research institution or university, employment agreement, funding agreement, the user agreements of any third-party content, tool or service provider. [see full report, p. 14, p. 19, p.37] Consult the legal department in your research institution if necessary, to discuss your plans. Identify the values of citizen science research and the user community's expectations for ethical operation of the project and ethical management of IP rights. [see full report, p. 28, p. 38] Determine your data sharing or publication responsibilities in any funding agreements.
	Identify any IP rights likely to arise from the project	Project-related IP may include a project website, software written specifically for the project, the project name and/or logos, compilations of research data, scientific reports or other publications, inventions, and so on. Consider who will have rights in these works/inventions, and how these rights should be managed. [see full report, p. 28, p. 39]
	Citizen scientists' level of involvement and access	Consider the research goals and the direction of research to define the nature of the public's involvement and the level of access to project outputs. The level of involvement and access should reflect any pre-existing IP agreement with project partners or funders. Consider whether participants will be making contributions in which they may have IP rights and manage these rights through a user agreement/license in a manner that is appropriate to the project goals. [see full report, p. 16, p. 39] Where necessary, implement security measures to prevent any unauthorized use or downloading of the project's contents, tools, and services (if possible). [see full report, p. 26]

	Plan data gathering and data sharing	If commercialization is a potential goal, consider ways your research might be commercialized or might become part of a commercial work so that you can protect the financial value of your research (or its patentability) by not over-sharing the research and by ensuring all rights are cleared (including in relation to user contributions). Consider whether there is a need to enforce a confidentiality agreement on research partners or citizen scientists during research. [see full report, p. 21, p. 26] Determine what type of data will be gathered and reported by citizen scientists and consider what format or tools will be used in this process. (For example, electronic forms may raise no contributor IP issues, whereas photographs and written observations do.) [see full report, p. 16] Decide what data will be shared, in what format, and how it will be shared (e.g. open access or proprietary). This can help you select an appropriate licensing scheme Consider the type of data you will be gathering and whether these data raise other legal and/or ethical considerations (such as privacy or obligations in relation to traditional knowledge). [see full report, p. 26]
	Prevent plagiarism or theft of research or of project goodwill	Consider registering the project name and its logos as trademarks to prevent unauthorized use. [see full report, p. 23, p. 47] Instead of releasing data into the public domain, share collected data using open access licensing (which may allow you to attach conditions such as attribution, non-commercial use, or share-alike) to ensure proper acknowledgement and to limit uses considered inconsistent with project goals. [see full report, Table IV, p. 51] Consider publishing research results (e.g. in open access journals) before making them available on the project website for public viewing.

Using third party tools, contents, and/or services in citizen science [see full report, p. 18, p. 37]	*Using web platforms and services (e.g. Facebook, SciStarter)*	Be aware of IP policies of the third party platform and communicate the existence of such policies to citizen scientists. The project's IP policy should reflect any restrictions of the third-party website or service provider to maintain consistency. If a portion of the project is hosted on a third-party website, give users notice whenever a link from the project website directs users to the external website where different terms and conditions may apply.
	Third party contents, tools, or software	Give citizen scientists notice before they interact with third-party contents. Identify unauthorized uses in the project's terms and conditions. Even if third-party contents are made available under an open access license, notify users of any limitations set out in the license (e.g. no commercial re-use). When there are multiple third-party contents or tools, clearly notify users in the terms and conditions that different terms may apply to each.
Participant contributions	*License enforceability* [see full report, p. 49]	Choose click-wrap agreements over browse-wrap where possible. Click-wrap agreements give notice of the user agreement and provide citizen scientists with an opportunity to read the terms and manifest assent prior to joining the project. In case of a browse-wrap agreement, place the link in locations that are logical and visible to a reasonably prudent user (e.g. consider whether the link is visible without scrolling and where it is located in relation to other important hyperlinks).
	Collecting participant contributions	Secure all necessary rights to use contributions of citizen scientists in the project and in related future activities. [see full report, p. 46] Obtain a waiver of moral rights from citizen scientists where project is on an international scale or in a country outside the United States. [see full report, p. 46] Include a disclaimer in case citizen scientists upload infringing contents. [see full report, p. 45]

	Drafting Terms and Conditions	Choose appropriate language – simple or complex – according to the circumstances of research. Where possible, use simple and accessible language. [see full report, p. 39, p. 44] Even when the project's IP policy is determined by an external source (e.g. research institution) and these terms are posted online elsewhere, consider distilling these principles into a simple license and providing links to other relevant documents where necessary. [see full report, p. 49] Choose governing law in case of a dispute and in case of possible changes to IP law. Try to clearly identify the conditions and the limitations of the license, such as the durationof the license and the type of use provided for. [see full report, p. 17, p. 34, p. 25, p. 37] Do not commit a copyright infringement by directly copying the terms and conditions of another project without permission. [see full report, p. 20, p. 49]
	Acknowledge participant contributions [see full report, p. 30]	Determine and explain how user contributions will be acknowledged (e.g. web-based acknowledgement by posting names or login names online). List contributors as co-authors in peer-reviewed publications when appropriate. Include contributors as co-inventors in patent applications when appropriate. Acknowledge collective contributions in publications and/or on website. Attribute citizen scientists when their copyright protected works (e.g. photos) are featured or displayed in announcements, publications, presentations, or demonstrations.

Research dissemination and commercialization	*Choose a method of publication*	Choose a vehicle for publication (e.g. proprietary publishers, open access journals, or the public domain) that is most appropriate for the project objectives.
	Dissemination [see full report, p. 23, p. 47]	Disclaim all warranties for user contributions. Where appropriate, include a statement of non-endorsement for third-party works or user contributions. If data or results are published under an open license, consider whether any use limitations are appropriate (e.g. non-commercial, share-alike). Consider also whether and how attribution should be made to the project in downstream uses. If considering trade secret protection, weigh its benefit against the benefit of openly sharing knowledge. [see full report, p. 26] Research dissemination should not breach any external IP restrictions imposed on the research.
	Commercialization	Patenting – consider the costs, the length of time, and the legal requirements for registering a patent in the countries where you plan to enforce your patent rights. Identify any possible participant co-inventors. [see full report, p. 21] Consider providing for an equitable sharing of royalties, particularly for inventions developed in the course of community-based projects. [see full report, p. 30]

Table VI: IP Checklist for Citizen Science Participants

- ✓ Consider the nature and type of contribution required by the citizen science project. Are contributions likely to be ones in which you have IP rights (e.g. photographs, written observations, or commentary, inventive activity)? Have you already assigned your IP rights in the content you plan to submit to someone else?
- ✓ How does the user agreement/licence address IP issues? Are you satisfied with the terms and conditions?
- ✓ Be aware that you should not contribute (and cannot licence the use of) content in which others hold the IP rights (e.g. photographs taken by others).
- ✓ What does the user agreement say about how your contributions will be used, shared, and disseminated (e.g. open access publications, data shared with other researchers, or with public at large)? Are you satisfied with the plans for use?
- ✓ What does the user agreement say about how any contributions will be acknowledged in publications, on the website, or in other project output? Are you satisfied with this?
- ✓ If you are part of a community-based project, are there clear provisions for how the community may use the project data or publications to address local problems?
- ✓ Is the objective of the research project consistent with your expectations? For example, how do you feel about your contribution being part of a proprietary (restricted access) research output?

BIBLIOGRAPHY

American Indian and Alaska Native Genetics Resource Center, "Havasupai Tribe and the lawsuit settlement aftermath", online: http://genetics.ncai.org/case-study/havasupai-tribe.cfm?pdf=1&.

Andanda, P.A. "Human-Tissue-Related Inventions: Ownership and Intellectual Property Rights in International Collaborative Research in Developing Countries." Journal of Medical Ethics 34.3 (2008): 171-179. Print.

Benkler, Yochai. *The Penguin and the Leviathan*. New York: Crown Publishing Group, 2011. Print.

Benkler, Yochai. *The Wealth of Networks: How Social Production Transforms Markets And Freedom.* New Haven, Conn: Yale University Press, 2006. Print.

Berkes, Fikret. "Traditional Ecological Knowledge in Perspective." *Traditional Ecological Knowledge: Concepts and Cases*. Ed. Julian T. Inglis. Ottawa: International Program on Traditional Ecological Knowledge and International Development Research Centre, 1993. 1-9. Print.

Bogers, Marcel, Rudi Bekkers, and Ove Granstrand. "Intellectual Property and Licensing Strategies in Open Collaborative Innovation." *Open Innovation at Firms and Public Administrations: Technologies for Value Creation.* Eds.C. de Pablos Heredero and D. López. Hershey, PA: IGI Global, 2012. 37-58. Print.

Bowser, Anne, and Lea Shanley. *New Visions in Citizen Science*. Case Study Series Vol. 3, Commons Lab, Wilson Center for International Scholars, 2013. Web. 10 Jun. 2015. <http://www.wilsoncenter.org/publication/new-visions-citizen-science>.

Bowser, Anne, Andrea Wiggins, and Robert D. Stevenson. "Data policies for Public Participation in Scientific Research: A Primer." Albuquerque, NM : DataOne Public Participation in Scientific Research Working Group, 2013. Web. 10 June 2015. <http://

www.birds.cornell.edu/citscitoolkit/toolkit/policy/Bowser%20et%20al%202013%20Data%20Policy%20Guide.pdf>.

Bubela, Tania, Garret A. FitzGerald, and E. Richard Gold. "Recalibrating Intellectual Property Rights to Enhance Translational Research Collaborations." *Science Translational Medicine* 4.122 (2012): n.pag. Web. 15 June 2015. <http://stm.sciencemag.org/content/4/122/122cm3>.

Burk, Dan L. "Intellectual Property in the Context of e-Science." *Journal of Computer-Mediated Communication* 12 (2007): 600-617. Print.

Burke, Adrienne. "Citizen Science Takes Off: Could Community Labs Hatch the Next Generation of Bio Innovators?" *Yahoo News UK & Ireland.* Forbes, 24 Oct. 2011. Web. 15 Mar. 2015. <https://uk.news.yahoo.com/citizen-science-takes-off-could-community-labs-hatch-224038589.html#VsNAnOy>.

Chokshi, Dave A., Michael Parker, and Dominic P. Kwiatkowski. "Data Sharing and Intellectual Property in a Genomic Epidemiology Network: Policies for Large-Scale Research Collaboration." *Bulletin of the World Health Organization* 84.5 (2006): 382-387. Print.

Cohen, Wesley M., and John P. Walsh. "Real Impediments to Academic Biomedical Research." *Innovation Policy and the Economy, Volume 8*. Eds. Adam B. Jaffe, Josh Lerner, and Scott Stern. N.p: University of Chicago Press, 2008. 1-30. Web. 10 June 2015. <http://www.nber.org/chapters/c5300>.

Conrad, Cathy C., and Krista G. Hilchey. "A Review of Citizen Science and Community-Based Environmental Monitoring: Issues and Opportunities." *Environmental Monitoring and Assessment* 176 (2011):273-291. Print.

Cook-Deegan, Robert, and Christopher Heaney. "Patents in Genomics and Human Genetics." *Annual Review of Genomics and Human Genetics* 11 (2010): 383-425. Web. N.d. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2935940>.

Corbet, Jonathan. "Open Street Map's Point of No Return."*Linux Info from the Source*. LWN.net, 12 Jan. 2011. Web. 10 June 2015. <https://lwn.net/Articles/422493/>.

Dreyfuss, Rochelle Cooper. "Does IP Need IP? Accommodating Intellectual Production Outside the Intellectual Property Paradigm." *Cardozo Law Review* 31.5 (2010):1437-1473. Print.

Executive Office of the President, Office of Science and Technology Policy, "Memorandum for the Heads of Executive Departments and Agencies", February 22, 2013, online:

https://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf

Frank, Martin. "Open but Not Free – Publishing in the 21st Century." *New England Journal of Medicine* 368.9 (2013):787-789. Print.

Franzoni, Chiara, and Henry Sauermann. "Crowd Science: The Organization of Scientific Research in Open Collaborative Projects." *Research Policy* 43 (2014): 1-20. Print.

Gold, Richard. "Avoiding the Mistakes of Biotech: How Intellectual Property can be Better Managed to Advance Nanotechnology Research." *Studies in Ethics, Law, and Technology* 3.3(2009): n.p Print.

Haeussler, Carolin. "Information-Sharing in Academia and the Industry: A Comparative Study." Munich Personal RePEc Archive Paper No 24415, 2010. Web. 10 June 2015. <http://mpra.ub.uni-muenchen.de/24415/>.

Hays, Amos, Peter L. Pulsifer, and J.P. Fiset. "The Nunaliit Cybercartographic Atlas Framework." *Developments in the Theory and Practice of Cybercartography: Applications and Indigenous Mapping.* Ed. D.R. Fraser Taylor. N.p.: Elsevier, 2014. 129-140. Print.

Helfer, Lawrence, and Graeme Austin. *Human Rights and Intellectual Property: Mapping the Global Interface.* Cambridge, UK: Cambridge University Press, 2011. Print.

Hogle, Doreen M. "Copyright for Innovative Biotechnological Research: An Attractive Alternative to patent or Trade Secret Protection." *Berkeley Technology Law Journal* 5 (1990): 75-127.

Holdren, John P. "Memorandum for the Heads of Executive Departments and Agencies." Executive Office of the President, Office of Science and Technology Policy, 22 Feb. 2013. Web. 10 June 2015. <https://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf>.

Hrynaszkiewicz, Iain, and Matthew J. Cockerill. "Open by Default: A Proposed Copyright License and Waiver Agreement for Open Access Research and Data in Peer-Reviewed Journals." BMC Research Notes 5:494 (2012): n.pag. Web. 15 June 2015. <http://www.biomedcentral.com/1756-0500/5/494>.

Landes, William M., and Richard A. Posner. The Economic Structure of Intellectual Property Law. Cambridge, MA: Belknap Press, 2003. Print.

Ledford, Heidi. "Collaborations: With All Good Intentions." *Nature* 452 (2008): 682-684. Web. 15 June 2015. <http://www.nature.com/news/2008/080409/full/452682a.html>.

Lei, Zhen, Rakhi Juneja, and Brian D. Wright. "Patents Versus Patenting: Implications of Intellectual Property Protection for Biological Research." *Nature Biotechnology* 27 (2009):36-40. Print.

Lieberstein, Marc, and Ashford Tucker. "Crowdsourcing and Intellectual Property Issues." *Association of Corporate Counsel*. 29 Aug. 2012. Web. 15 June 2015. <http://www.acc.com/legalresources/quickcounsel/caipi.cfm>.

Livingston, Geoff. "The Challenges of Protecting Intellectual Property on Social Networks." *Your Nonprofit Technology Community*. N.p., 24 Mar. 2011. Web. 19 June 2015.<http://www.nten.org/blog/2011/03/24/challenges-protecting-intellectual-property-social-networks>.

Madison, Michael J. "Commons at the intersection of peer production, citizen science, and big data: Galaxy Zoo." *Governing Knowledge Commons.* Eds. Brett M Frischmann et al. New York: Oxford University Press, 2014. 209-254. Print.

National Institutes of Health, "Final NIH Statement on Sharing Research Data." 26 Feb. 2003. Web. 10 June 2015. <http://grants.nih.gov/grants/guide/notice-files/NOT-OD-03-032.html>.

Newman, Greg, et al. "The Future of Citizen Science: Emerging Technologies and Shifting Paradigms." *Frontiers in Ecology and the Environment* 10.6 (2012): 298-304. Print.

Office of the Secretary, National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, "The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research, Report of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research." *US Department of Health & Human Services*. HHS.gov, 18 Apr. 1979. Web. 10 June 2015. <http://www.hhs.gov/ohrp/humansubjects/guidance/belmont.html>.

Petherbridge, Lee. "Road Map to Revolution? Patent-Based Open Science." *Main Law Review* 59 (2007):339-383. Print.

Raddick, M Jordan, et al. "Galaxy Zoo: Exploring the Motivations of Citizen Science Volunteers." *Astronomy Education Review* 9 (2010): n.pag. Print.

Rai, Arti K. "Critical Commentary on 'Open Source' in the Life Sciences." *Gene Patents and Collaborative Licensing Models: Patent Pools, Clearinghouses, Open Source Models and Liability Regimes.* Ed. Geertrui van Overwalle. Cambridge: Cambridge University Press, 2009. 213-218. Print.

Rai, Arti K., and Rebecca S. Eisenberg. "Bayh-Dole Reform and the Progress of Biomedicine." *Law and Contemporary Problems* 66 (2003): 289-314. Print.

Resnik, D.B., Elliott, K.C., and A.K. Miller, "A framework for addressing ethical issues in citizen science", (2015) *Environ. Sci. Policy*, http://dx.doi.org/10.1016/j.envsci.2015.05.008

Salin, Patrick A. "Proprietary Aspects of Commercial Remote-Sensing Imagery." *Northwestern Journal of International Law & Business* 13 (1992): 349-373. Print.

Saunders, Adam, Teresa Scassa, and Tracey Lauriault. "Legal Issues in Maps Built on Third Party Base Layers." *Geomatica* 66.4 (2012): 279-290. Print.

Scassa, Teresa, and Haewon Chung. "Typology of Citizen Science Projects from an Intellectual Property Perspective: Invention and Authorship Between Researchers and Participants." Policy Memo Series, Vol. 5, Commons Lab, Wilson Center for International Scholars, 2015. Web. 10 June 2015. <http://www.wilsoncenter.org/publication/typology-citizen-science-projects-intellectual-property-perspective>.

Scassa, Teresa, Tracey Lauriault, and D.R. Fraser Taylor. "Cybercartography and Traditional Knowledge: Responding to Legal and Ethical Challenges." *Developments in the Theory and Practice of Cybercartography: Applications and Indigenous Mapping.* Ed. D.R. Fraser Taylor. Elsevier, 2014. 279-297.

Secretariat of the Convention on Biological Diversity. 2011. *Nagoya protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilisation to the convention on biological diversity*. Montreal, QC: Secretariat of the Convention on Biological Diversity; Secretariat of the Convention on Biological Diversity. 2011.

Shirk, Jennifer L., et al. "Public Participation in Scientific Research: A Framework for Deliberate Design." *Ecology and Society* 17.2 (2012): N.pag. Web. N.d. <http://dx.doi.org/10.5751/ES-04705-170229>.

Simcoe, Tim. "Open Standards and Intellectual Property Rights." *Open Innovation: Researching a New Paradigm* Eds. Henry Chesbrough, Wim Vanhaverbeke, and Joel West. Oxford: Oxford University Press, 2006. 161-183. Print.

Simpson, Robert, Kevin R. Page and David De Roure. "Zooniverse: Observing the World's Largest Citizen Science Platform." *The 23rd International World Wide Web Conference, Seoul, Korea, 7-11 Apr. 2014*. Web. June 10, 2015. <http://wow.oerc.ox.ac.uk/wow-2014-papers/zooniverse-observing-the-world2019s-largest-citizen-science-platform/view>.

Smith, Matthew L., and Katherine M. A. Reilly. Eds. *Open Development: Networked Innovations in International Development*. MA: MIT Press, 2013. Print.

Smith, Oliver. "Facebook Terms and Conditions: Why You Don't Own Your Online Life." *The Telegraph.* N.p., 4 Jan. 2013. Web. 15 June 2015. <http://www.telegraph.co.uk/technology/social-media/9780565/Facebook-terms-and-conditions-why-you-dont-own-your-online-life.html>.

The Tkarihwaié:ri Code of Ethical Conduct to Ensure Respect for the Cultural and Intellectual Heritage of Indigenous and Local Communities Relevant to the Conservation and Sustainable Use of Biological Diversity. Available at http://www.cbd.int/traditional/code/ethicalconduct-brochure-en.pdf.

United Nations Educational, Scientific and Cultural Organization. 1985. *Model Provisions for National Laws on the Protection of Expressions of Folklore Against Illicit Exploitation and Other Prejudicial Actions*. Available at http://www.wipo.int/wipolex/en/text.jsp?file_id=184668.

Wiggins, Andrea, and K. Crowston. "From Conservation to Crowd Sourcing: A Typology of Citizen Science." *Proceedings of the 44th Hawaii International Conference on System Sciences, Hawaii, USA, 4-7 Jan. 2011.* N.p.: IEEE, 2011. Web. N.d. <http://crowston.syr.edu/content/conservation-crowdsourcing-typology-citizen-science>.

World Intellectual Property Organization (WIPO) Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore. *The Protection of Traditional Knowledge: Revised Objectives and Principles*. Eighth Session, Geneva, 6-10 June, 2005; United Nations. 1992

CASES

AEB & Associates Design Group, Inc. v Tonka Corp, 853 F Supp 724, 732 (SDNY 1994).

Association for Molecular Pathology v. Myriad Genetics, Inc. 133 S. Ct. 2107, 186 L. Ed. 2d 124 (2013).

A.V. et al v iParadigms, LLC, 544 F Supp 2d 473 (ED Va, Mar. 11, 2008).

Campbell v. Acuff-Rose Music, 510 US 569 (1994) (parody is fair use); *Cariou v. Prince*, 714 F. 3d 694 (2d Cir 2013)

Diamond v. Chakrabarty, 447 U.S. 303 at 308 (1980).

Feist Publications, Inc. v. Rural Telephone Service Co., 499 U.S. 340, 111 S.Ct. 1282 (1991).

Hines v Overstock.com Inc, 668 F Supp (2d) 362, 2009 WL 2876667 (EDNY 2009)

Ingle v Circuit City Stores Inc, 328 F(3d) 1165 (9th Cir 2003).

Kewanee Oil Co. v. Bicron Corp., 416 U.S. 470, 94 S.Ct. 1879, 40 L.Ed.2d 315 (1974).

Madey v Duke University, 307 F 3d 1351, 1362 (Fed Circ 2002).

Mason v. Montgomery Data Inc, 967 F 2d 135 (5th Cir 1992)

MoneyIN, Inc. v. VeriSign, Inc., 545 F.3d 1359, 1371 (Fed. Cir. 2008).

New Kids on the Block v New America Publishing Inc, 971 F.2d 302 (9th Cir 1992).

Pollstar v Gigmania Ltd, 170 . Supp (2d) 974, 981 (ED Cal 2000)

Scherillo v Dun & Bradstreet Inc, 684 F Supp (2d) 313 (EDNY 2010)

Tradecomet.com LLC v Google Inc, 693 F Supp (2d) 370 (SDNY 2010) \

STATUTES:

Uniform Trade Secrets Act § 1(4)(i)-(ii), 14 U.L.A. 537-51 (1985 & Supp. 1990).

Copyright Act, Title 17 of the United States Code.

Computer Fraud and Abuse Act, 18 U.S. C. §1030.

Patent Act, Title 35 of the United States Code.

Trademark Act, Title 15 of the United States Code.

International Instruments:

Berne Convention for the Protection of Literary and Artistic Works, 9 September 1886, 828 UNTS 221

Convention on Biological Diversity, 5 June, 1760 U.N.T.S. 79, 31 I.L.M. 818.

United Nations Declaration on the Rights of Indigenous Peoples, GA Res. 61/295, UN GAOR, 61st Sess., Supp. No. 49 Vol. III, UN Doc. A/61/49 (2007).

ENDNOTES

1 Anne Bowser and Lea Shanley. 2013. *New Visions in Citizen Science*. Wilson Center, Commons Lab, Case Study Series, Vol. 3 at 45.

2 Anne Bowser and Lea Shanley. 2013. *New Visions in Citizen Science*. Wilson Center, Commons Lab, Case Study Series, Vol. 3 at 45.

3 Ibid. Participatory action research is also known as community-based natural resource monitoring.

4 Jennifer L. Shirk, H. L. Ballard, C. C. Wilderman, T. Phillips, A. Wiggins, R. Jordan, E. McCallie, M. Minarchek, B. V. Lewenstein, M. E. Krasny, and R. Bonney. 2012. Public participation in scientific research: a framework for deliberate design. *Ecology and Society* 17(2): 29. http://dx.doi.org/10.5751/ES-04705-170229 at 30.

5 Ibid.

6 There are some similarities between citizen science and crowd-sourcing activities more generally. Citizen science is distinguishable from many crowd-sourcing activities by its scientific method and intent. There can be considerable overlap in the IP issues raised by both types of activities. However, many of the institutional and multi-stakeholder dimensions of citizen science will be quite distinct.

7 United States Constitution, Article I, Section 8, Clause 8.

8 Perhaps the most well-known exception in copyright law is the one for "fair use": 17 U.S.C. §107.

9 In the U.S., the Copyright Term Extension Act of 1998, Pub.L. 105-298, extended the term of copyright protection from the life of the author plus fifty years, to life of the author plus 70 years.

10 For example, in Europe, the *European Database Directive96/9/EC of the European Parliament and of the Council of the European Union of 11 March 1996 on the legal protection of databases*, [1996] O.J. L 77/20, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31996L0009:EN:HTML, created a new *sui generis* right in databases and their contents.

11 For example, the controversial Anti-Counterfeiting Trade Agreement is an international agreement that proposes

strong new enforcement measures to address global IP counterfeiting. See:

12 See, e.g.: Michael J Madison, "Commons at the intersection of peer production, citizen science, and big data: Galaxy Zoo", in Brett M Frischmann et al, eds, *Governing Knowledge Commons* (New York: Oxford University Press, 2014). See also: Chiara Franzoni & Henry Sauermann, "Crowd Science: the organization of scientific research in open collaborative projects," (2014) *Research Policy* 43; 1-20 at 8.

13 See, e.g.: Adrienne Burke, "Citizen Science Takes Off: Could Community Labs Hatch the Next Generation of Bio Innovators?", Forbes.com, October 24, 2011, online: https://uk.news.yahoo.com/citizen-science-takes-off-could-community-labs-hatch-224038589.html#VsNAnOy; Madison, ibid.

14 Andrea Wiggins and K. Crowston. 2011. "From Conservation to Crowd Sourcing: A Typology of Citizen Science". Proceedings of the 44th Hawaii International Conference on System Sciences (2011), online: http://crowston.syr.edu/content/conservation-crowdsourcing-typology-citizen-science, at 2; Dan L. Burk, "Intellectual Property in the Context of e-Science", Journal of Computer-Mediated Communication 12 (2007) 600-617, at 614.

15 Madison, *supra* note 12 at 215. Wiggins & Crowston, ibid, create a typology of citizen science projects ased on kinds of activities engaged in by volunteers.

16 Note, however, that these goals may still be present, and may manifest themselves in different ways. Franzoni and Sauerman, *supra* note 12 at 9, observe that "the logic of the reward system of the traditional institution of science" leads to a lack of openness.

17 17 U.S.C. § 102(a).

18 17 U.S.C. §103.

19 In *Mason v. Montgomery Data Inc*, 967 F 2d 135 (5th Cir 1992) a map was characterized as a copyrightable compilation of facts.

20 17 U.S.C.§102(b).

21 Feist Publications, Inc. v. Rural Telephone Service Co., 499 U.S. 340, 111 S.Ct. 1282 (1991).

22 Landes and Posner also express doubts as to whether massive electronic databases constitute an original arrangement of data for similar reasons. See: William M. Landes & Richard A. Posner, The Economic Structure of Intellectual Property Law (Cambridge, MA: Belknap Press, 2003) at 104. See also: Burk, *supra* note 14, at 602.

23 For example, in *Feist*, *supra* note 21, the U.S. Supreme Court found that the alphabetical arrangement of information in a telephone directory lacked the originality necessary to give rise to copyright in this compilation of data.

24 *Feist*, *supra* note 21 at 349.

25 Burk, *supra* note 14, at 602.

26 Teresa Scassa and Haewon Chung, "Typology of Citizen Science Projects from an Intellectual Property Perspective: Invention and Authorship Between Researchers and Participants", Policy Memo Series, Vol. 5, Commons Lab, Wilson Center for International Scholars, February 2015, online: http://www.wilsoncenter.org/publication/typology-

citizen-science-projects-intellectual-property-perspective.

27 A few examples of projects in which participants engage in classification activities include: Bat Detective (http://www.batdetective.org/), Cyclone Center (http://www.cyclonecenter.org/), The Milky Way Project (http://www.milkywayproject.org/), Seafloor Explorer (http://www.seafloorexplorer.org/), and Snapshot Serengeti (http://www.snapshotserengeti.org/).

28 This is a fairly common practice. See, for example, the projects listed in Scassa & Chung, *supra* note 26.

29 See: Old Weather: The Weather's Past the Climate's Future, online: http://www.oldweather.org/. Other transcription projects include: Ancient Lives (http://www.ancientlives.org/), and Notes From Nature (http://www.notesfromnature.org/).

30 To describe the effort involved as copying in not to diminish the importance of the activity to the advancement of scientific research, as the accurate transcription of old, handwritten notes so as to provide a digital research resource can be enormously important. The point here is simply that accurate transcription is not the type of activity that is recognized as giving rise to copyright.

31 See: eBird, online: http://ebird.org/content/ebird/.

32 See, for example, Cathy C. Conrad & Krista G. Hilchey, "A review of citizen science and community-based environmental monitoring: issues and opportunities", Environ Monit Assess (2011) 176:273-291. Examples of projects include: Delaware Bay Horseshoe Crab Spawning Survey, online: http://www.dnrec.delaware.gov/coastal/DNERR/Pages/DNERRHSCSpawningSurvey.aspx.

33 See, for example, The Lost Ladybug Project, online: http://www.lostladybug.org/; iNaturalist, online: http://www.inaturalist.org/; The Smell Experience Project, online: http://scistarter.com/project/112-The%20Smell%20Experience%20Project.

34 The Polymath Project, for example, invites a back and forth exchange of ideas related to the solving of mathematical problems: http://polymathprojects.org/.

35 This is made clear in 17 U.S.C. §201(c), which provides that "Copyright in each separate contribution to a collective work is distinct from copyright in the collective work as a whole, and vests initially in the author of the contribution. In the absence of an express transfer of the copyright or of any rights under it, the owner of copyright in the collective work is presumed to have acquired only the privilege of reproducing and distributing the contribution as part of that particular collective work, any revision of that collective work, and any later collective work in the same series."

36 See, for example: Adam Saunders, Teresa Scassa and Tracey Lauriault, "Legal Issues in Maps Built on Third Party Base Layers", (2012) 66:4 *Geomatica* 279-290.

37 Note that the terms go on to provide: "This IP License ends when you delete your IP content or your account unless your content has been shared with others, and they have not deleted it." See: Facebook, Terms of Service, online: https://www.facebook.com/legal/terms. See: Geoff Livingston, "The Challenges of Protecting Intellectual Property on

Social Networks", Non Profit Technology Network, March 24, 2011, online: http://www.nten.org/blog/2011/03/24/challenges-protecting-intellectual-property-social-networks; Oliver Smith, "Facebook terms and conditions: why you don't own your online life", The Telegraph, January 4, 2013, online: http://www.telegraph.co.uk/technology/social-media/9780565/Facebook-terms-and-conditions-why-you-dont-own-your-online-life.html.

38 Google, Google Terms of Service, April 30, 2014, online: https://www.google.ca/intl/en/policies/terms/regional.html.

39 Zooniverse can be found at: https://www.zooniverse.org/. See also: Robert Simpson, Kevin R. Page and David De Roure, "Zooniverse: Observing the World's Largest Citizen Science Platform", WWW'14 Companion, April 7-11, 2014, Seoul, Korea. http://dx.doi.org/10.1145/2567948.2579215; Franzoni & Sauerman, *supra* note 12 at 6.

40 Open Street Map, Copyright and Licence, online: http://www.openstreetmap.org/copyright. This type of term is known as "share alike".

41 See, e.g.: Patrick A. Salin, "Proprietary Aspects of Commercial Remote-Sensing Imagery", 13 Nw. J. Int'l L. & Bus. 349, at 361-362. See also Burk, *supra* note 14 at 608, who argues that this type of image is more likely to be treated, in the United States, as a "fact" or compilation of facts.

42 The ultimate determination of whether copyright subsists in a given work is for a court to make. Nevertheless, rights can be asserted even where a court has yet to decide that such a right exists. For example, a company may send a letter demanding that another entity cease and desist from using materials over which they claim copyright, and threatening to sue if they do not.

43 See, e.g., Burk, *supra* note 14 at 608.

44 17 U.S.C. § 105.

45 For example Great Britain and other Commonwealth countries such as Canada, New Zealand and Australia have "Crown" copyright which is essentially a form of copyright held and exercised by the state in relation to works created by government and its institutions.

46 Burk, *supra* note 14 at 608, notes how different jurisdictions will take different approaches to this question.

47 For example, Galaxy Zoo uses publicly available Sloan Digital Sky Survey images. These images are available under a royalty free licence for non-commercial uses: http://www.sdss.org/collaboration/#image-use. This use of open source materials might limit the ability to commercialize downstream research if the open access contents are distributed via non-commercial use license.

48 17 U.S.C. § 105.

49 17 U.S.C. § 302(a).

50 See 17 U.S.C. § 408(a). Note that a work must be registered for its author to bring suit for copyright infringement of that work (17 U.S.C. § 411). Registration may take place at any time during the term of copyright protection (§408).

51 Where such a notice is placed on a work, a defendant in a copyright infringement suit cannot rely on the

defence of innocent infringement. See §401(d).

52 17 U.S.C. § 201(a)

53 17 U.S.C. § 201(b).

54 It is increasingly common for universities and research institutions to address these issues in intellectual property policies and in employment-related documents. See, for example: Stanford Universities, DoResearch Policies, Chapter 9, Intellectual Property, online: https://doresearch.stanford.edu/policies/research-policy-handbook/intellectual-property; Cornell University Policy Library, Policy 1.5, Inventions and Related Property Rights, online: http://www.dfa.cornell.edu/dfa/cms/treasurer/policyoffice/policies/volumes/academic/upload/vol1_5.pdf; University of Southern California Intellectual Property Policy, April 3, 2001, online: https://policy.usc.edu/files/2014/02/intellectual_property.pdf.

55 17 U.S.C. § 201(d). A partial transfer may, for example, be of the rights in one country or region (e.g. North American rights), or for a defined period of time. It is also possible to transfer only a subset of rights, such as the right to reproduce the work, or the right to adapt the work for film or television.

56 17 U.S.C. § § 204(a).

57 Creative Commons: online http://www.creativecommons.org.

58 For example, Anne Bowser, Andrea Wiggins, & Robert D. Stevenson, (2013). Data policies for Public Participation in Scientific Research: A primer. DataONE: Albuquerque, NM, online: http://www.birds.cornell.edu/citscitoolkit/toolkit/policy/Bowser%20et%20al%202013%20Data%20Policy%20Guide.pdf, at p. 7, off the example of the Great Worldwide Star Count, that uses different Creative Commons licences to licence, on the one hand, their data, and on the other, their teaching tools.

59 For example, the Terms of Service for iNaturalist provide: "By submitting Content to iNaturalist for inclusion on your Website, you grant iNaturalist a world-wide, royalty-free, and non-exclusive license to reproduce, modify, adapt and publish the Content solely for the purpose of displaying, distributing and promoting your observations and journal." (iNaturalist, Terms of Service, http://www.inaturalist.org/pages/terms.)

60 17 U.S.C. § 501(a).

61 17 U.S.C. § 107.

62 See, e.g.: *Campbell v. Acuff-Rose Music*, 510 US 569 (1994) (parody is fair use); *Cariou v. Prince*, 714 F. 3d 694 (2d Cir 2013) (transformative use is fair use).

63 17 U.S.C. § 107.

64 Dave A. Chokshi, Michael Parker, & Dominic P. Kwiatkowski, "Data sharing and intellectual property in a genomic epidemiology network: policies for large-scale research collaboration", (2006) Bulletin of the World Health Organization, 84(5): 382-387, at 384.

65 35 U.S.C. § 101.

66 See, e.g.: *Madey v Duke University*, 307 F 3d 1351, 1362 (Fed Cir 2002).

67 *Diamond v. Chakrabarty*, 447 U.S. 303 at 308 (1980).

68 *Diamond v. Chakrabarty,* 447 U.S. 303, 309.

69 *Association for Molecular Pathology v. Myriad Genetics, Inc. 133 S. Ct. 2107,* 186 L. Ed. 2d 124 (2013).

70 See, e.g.: Lost Ladybug Project (http://www.lostladybug.org/); eBird (http://ebird.org/content/ebird/).

71 See, e.g.: Old Weather: Our Weather's Past the Climate's Future, online: http://www.oldweather.org/; Ancient Lives (http://www.ancientlives.org/), and Notes From Nature (http://www.notesfromnature.org/).

72 See, e.g.: Missouri Stream Team, online: http://www.mostreamteam.org/; New York-New Jersey Harbor & Estuary Program, online: http://www.harborestuary.org/citizenscience.htm; Air Quality Egg, online: http://airqualityegg.com/.

73 Many existing or finished citizen science projects typically asked public participants to carry out simple or non-technical tasks such as answering a survey, providing opinions and ideas, reporting their observations about the world, and performing simple modular tasks. However, as technology evolves further it will be increasingly possible for public participants to perform complex tasks that may lead to patentable inventions.

74 35 U.S.C. § 101.

75 Lee Petherbridge, "Road Map to Revolution? Patent-Based Open Science", 59 Me. L. Rev. 339-383 at 348-49 (2007).

76 For example, Foldit anticipates the possibility that patents may result from participation in its game-based citizen science project. See: Foldit, online: https://fold.it/portal/node/998109.

77 Chokshi et al, *supra* note 64 at 382.

78 For considerations that may arise in the context of genomic research, see Chokshi et al, *supra* note 64 at 384.

79 Patent Act, 35 U.S.C. § 102.

80 This exception is available only for patent applications in the United States and Canada. Absolute novelty (i.e. no disclosure by anyone prior to filing) is still required for patenting in other countries.

81 *MoneyIN, Inc. v. VeriSign, Inc*., 545 F.3d 1359, 1371 (Fed. Cir. 2008).

82 Pub. L. 96-517, December 12, 1980.

83 See, for example, the trademark registration for eBIRD (Registration #2793417).

84 See, for example, the trademark registration for PatientsLikeMe (Registration #3577623).

85 See, for example, the trademark registration for EarthWatch (Registration #2154564).

86 15 U.S.C. § 1125(a) (this section of the Lanham Act provides trademark owners with the right to obtain civil remedies against those who made unauthorized uses of their trademarks in false adver-

tisements or deceptive or misleading statements in commerce.)

87 United States Patent and Trademark Office, Trademark Electronic Search System: http://tess2.uspto.gov/bin/gate.exe?f=tess&state=4810:25ni83.1.1.

88 The two most significant other ways in which harm can arise are through what is known as dilution by blurring or by tarnishment. Dilution by blurring occurs where the use of a similar mark would dilute the value of a famous mark by undermining (or blurring) its distinctiveness. Dilution can occur even if there is no confusion as to source. Dilution by tarnishment occurs where the use of a similar mark would harm the reputation of a famous mark. See: 15 U.S.C. § 1125. Nonetheless, under trademark fair use, non-owners or competitors may use trademarks in a descriptive sense or use trademarks in nominative or referential sense to refer to the actual source of the trademark or the trademarked goods. *New Kids on the Block v New America Publishing Inc*, 971 F.2d 302(9th Cir 1992).

89 Registered since 1998, to Earthwatch Institute, Inc. (Current owner).

90 Registered since 2003 to the National Audubon Society.

91 Registered since 2009 to PatientsLikeMe Inc.

92 Registered since 2012 to 23andMe, Inc. Note that 23andMe Inc. also owns a number of other trademarks related to its website and services.

93 Registered since 2014 to Julia Drapkin.

94 Registered since 2015 to California Academy of Sciences.

95 For example, the Terms of Use for PatientsLikeMe provide: "PatientsLikeMe® and the PatientsLikeMe logo are trademarks of PatientsLikeMe. You agree not to display or use these trademarks in any manner without PatientsLikeMe's prior, written permission." (See, online: http://www.patientslikeme.com/about/user_agreement)

96 15 U.S.C. §1508.

97 Fikret Berkes, "Traditional ecological knowledge in perspective". In *Traditional Ecological Knowledge: Concepts and Cases*, J. T. Inglis ed., Ottawa: International Program on Traditional Ecological Knowledge and International Development Research Centre, 1993, 1-9, at 3.

98 Convention on Biological Diversity. 2012. *Introduction: Traditional Knowledge and the Convention on Biological Diversity*. Available at http://www.cbd.int/traditional/intro.shtml.

99 Teresa Scassa, Tracey Lauriault, & D.R. Fraser Taylor, "Cybercartography and Traditional Knowledge: Responding to Legal and Ethical Challenges" in D.R. Fraser Taylor, ed., *Developments in the Theory and Practice of Cybercartography: Applications and Indigenous Mapping* (Elsevier 2014), pp. 279-297 at 281.

100 The United States is not unique in this regard. There is, as yet, little international consensus on what the parameters of any domestic protection for traditional knowledge should be.

101 See, e.g.: World Intellectual Property Organization (WIPO) Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore. *The Protection of Traditional Knowledge: Revised Objectives and Principles*. Eighth Session, Geneva, 6-10 June, 2005; United Nations. 1992. *Convention on Biological Diversity*, 5 June, 1760 U.N.T.S. 79, 31 I.L.M. 818; *United Nations Declaration on the Rights of Indigenous Peoples*, GA Res. 61/295, UN GAOR, 61st Sess., Supp. No. 49 Vol. III, UN Doc. A/61/49 (2007); United Nations Educational, Scientific and Cultural Organization. 1985. *Model Provisions for National Laws on the Protection of Expressions of Folklore Against Illicit Exploitation and Other Prejudicial Actions*. Available at http://www.wipo.int/wipolex/en/text.jsp?file_id=184668; Secretariat of the Convention on Biological Diversity. 2011. *Nagoya protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilisation to the convention on biological diversity*. Montreal, QC: Secretariat of the Convention on Biological Diversity; Secretariat of the Convention on Biological Diversity. 2011. *The Tkarihwaié:ri Code of Ethical Conduct to Ensure Respect for the Cultural and Intellectual Heritage of Indigenous and Local Communities Relevant to the Conservation and Sustainable Use of Biological Diversity*. Available at http://www.cbd.int/traditional/code/ethical-conduct-brochure-en.pdf.

102 Lawrence Helfer, and Graeme Austin, (2011). *Human Rights and Intellectual Property: Mapping the Global Interface*. Cambridge, UK: Cambridge University Press, Chapter 7.

103 See, e.g: D.B. Resnik et al, "A framework for addressing ethical issues in citizen science", (2015) *Environ. Sci. Policy*, http://dx.doi.org/10.1016/j.envsci.2015.05.008, at 5.

104 A settlement reached in 2010 between the Havasupai Tribe and the Board of Regents for Arizona State University highlights the importance of obtaining clear and informed consent for the collection and use of research materials. In this case, researchers collected genetic material in the context of a diabetes study. They later used this material for other purposes without consent. See: American Indian and Alaska Native Genetics Resource Center, "Havasupai Tribe and the lawsuit settlement aftermath", online: http://genetics.ncai.org/case-study/havasupai-tribe.cfm?pdf=1&.

105 Matthew L Smith & Katherine M A Reilly, eds, *Open Development: Networked Innovation in International Development* (Cambridge, MA: The MIT Press, 2013) at 55.

106 See, for example, the discussion in: Amos Hays, Peter L. Pulsifer, and J.P. Fiset, "The Nunaliit Cybercartographic Atlas Framework", in D.R. Fraser Taylor, ed., *Developments in the Theory and Practice of Cybercartography: Applications and Indigenous Mapping* (Elsevier 2014), pp. 129-140.

107 See, for example the Mukurtu project (http://www.mukurtu.org), which has developed a suite of template traditional knowledge licences: http://www.mukurtu.org/node/27.

108 Carolin Haeussler, "Information-sharing in academia and the industry: a comparative study" (2010) Munich Personal RePEc Archive Paper No 24415, online: http://mpra.ub.uni-muenchen.de/24415/, at 7.

109 The terms "trade secret" and "confidential information" are generally interchangeable as far as it relates to the substance of the law that protects

secret information with commercial value. The term 'trade secret' is more commonly used to refer to secrets with industrial application such as processes, formulae, and so on. 'Confidential information' is used to refer to secret compilations of information such as research data, client lists and so on.

110 Hogle states: "Trade secret protection allows the scientist to conceal any innovative scientific information until she is ready to surrender control." (Doreen M. Hogle, "Copyright for Innovative Biotechnological Research: An Attractive Alternative to patent or Trade Secret Protection.", (1990) 5 Berkeley Technology Law Journal 75, at 79.

111 Uniform Trade Secrets Act § 1(4)(i)-(ii), 14 U.L.A. 537-51 (1985 & Supp. 1990). This Act is not a statute per se, but rather is a model law that can be adopted by state legislatures (see: *Kewanee Oil Co. v. Bicron Corp.*, 416 U.S. 470, 94 S.Ct. 1879, 40 L.Ed.2d 315 (1974)). Unlike patents or copyrights, jurisdiction over the protection of trade secrets and confidential information lies with the states. The Uniform Trade Secrets Act has been enacted in 47 states.

112 See, for example: Office of the Secretary, National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, *Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research, Report of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research*, April 18, 1979, online: http://www.hhs.gov/ohrp/humansubjects/guidance/belmont.html.

113 For example, the *Computer Fraud and Abuse Act* 18 U.S.C. §1030, prohibits the misuse of a third party's computers and provides for criminal and civil remedies.

114 Burk, *supra* note 14 at 604, observes that the incentive/reward system in the sciences has not generally involved patenting. Rather, "[s]cientists are expected to contribute their discoveries freely to the community." This view has been somewhat displaced by a growing emphasis on patenting. See, e.g.: Marcel Bogers, Rudi Bekkers, Ove Granstrand, (2012) "Intellectual Property and Licensing Strategies in Open Collaborative Innovation". In C. de Pablos Heredero & D. López (Eds.), Open Innovation at Firms and Public Administrations: Technologies for Value Creation (pp. 37-58). Hershey, PA: IGI Global, at 38-39.

115 For example, iNaturalist provides in its terms of service: "If you believe that material located on or linked to by iNaturalist.org violates your copyright, you are encouraged to notify iNaturalist. iNaturalist will respond to all such notices, including as required or appropriate by removing the infringing material or disabling all links to the infringing material. In the case of a visitor who may infringe or repeatedly infringes the copyrights or other intellectual property rights of iNaturalist or others, iNaturalist may, in its discretion, terminate or deny access to and use of the Website." (iNaturalist, Terms of Service, http://www.inaturalist.org/pages/terms.)

116 Franzoni and Sauerman, *supra* note 12 at 15, put Galaxy Zoo, Phylo and Foldit in this category.

117 Madison, *supra* note 12.

118 Franzoni and Sauerman, ibid, note that Polymath uses.

119 See, e.g.: Resnik et al, *supra* note 103.

120 Madison, *supra* note 12. Benkler notes that studies have shown that people are intrinsically driven to cooperate with others and that they may be motivated by both material and non-material rewards. See Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets And Freedom* (New Haven, Conn: Yale University Press, 2006).

121 Resnik et al, *supra* note 103.

122 For example, obtaining a patent over some inventions may be a means of ensuring some form of control over how that invention and any patentable improvements to it, are made available for use. In some fields, the research investment is such that patenting may be necessary to recover costs and to fund further research.

123 For a discussion of some of the ethical issues raised by genetic research, see: P.A. Andanda, "Human-Tissue-Related Inventions: Ownership and Intellectual Property Rights in International Collaborative Research in Developing Countries", (2008) 34:3 Journal of Medical Ethics 171-179.

124 Note that our survey of citizen science project co-ordinators showed that transparency and open communication was a very important consideration for almost all respondents.

125 See: Bowser, et al, *supra* note 58.

126 For example, the Research Councils UK set aside approximately 160 million dollars in 2012 to promote open access publication of publicly funded research in the UK. See: Martin Frank, "Open but Not Free – Publishing in the 21st Century" (2014) 368:9 New Eng J Med 787 at 788.

127 Zooniverse, "Zooniverse User Agreement and Privacy Policy", online: https://www.zooniverse.org/privacy.

128 CitizenSort, "Citizen Sort User Agreement, Privacy Policy & Informed Consent", online: http://www.citizensort.org/web.php/terms.

129 *Copyright Act*, 17 U.S.C. §204(a).

130 Andanda, *supra* note 123.

131 See: Scassa & Chung, *supra* note 26.

132 Executive Office of the President, Office of Science and Technology Policy, "Memorandum for the Heads of Executive Departments and Agencies", February 22, 2013, online: https://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf. The National Institutes of Health also has a policy on data sharing. While it does not mandate open access in all circumstances, it does require researchers to address data sharing issues. See: National Institutes of Health, *Final NIH Statement on Sharing Research Data*, February 26, 2003, online: http://grants.nih.gov/grants/guide/notice-files/NOT-OD-03-032.html.

133 Bowser *et al*, *supra* note 58 at 5, note that the placement of notices of terms of use or licences on a web site may be relevant to issues of enforceability, since terms and conditions that are not reasonably brought to the attention of users may not be enforceable against them.

134 Zooniverse, "Zooiniverse User Agreement and Privacy Policy", online: https://www.zooniverse.org/privacy.

135 Ibid.

136 See, for example, Jonathan Corbet, "Open Street Map's Point of No Return", January 12, 2011, LWN.net, online: https://lwn.net/Articles/422493/;

137 Nature's Notebook, USA-NPN Website Terms of Use, online: https://www.usanpn.org/terms.

138 *Berne Convention for the Protection of Literary and Artistic Works,* 9 September 1886, 828 UNTS 221, article 6 *bis*.

139 An example of an attribution can be found in the terms of use for NASA Be a Martian, which requires those who uses images or videos from its site to acknowledge the project by inserting "Courtesy NASA/JPL-Caltech". See: NASA Be a Martian, online: JPL Image Use Policy, http://www.jpl.nasa.gov/imagepolicy/.

140 Ibid.

141 *Tradecomet.com LLC v Google Inc*, 693 F Supp (2d) 370 (SDNY 2010), *Scherillo v Dun & Bradstreet Inc*, 684 F Supp (2d) 313 (EDNY 2010). It should be noted that any contract made by a minor is typically voidable in the U.S. However, under narrow circumstances, courts may determine that minors who entered into a standardized electronic contract may be bound by its terms and conditions. For example, in *A.V. et al v iParadigms, LLC*, 544 F Supp 2d 473 (ED Va, Mar. 11, 2008), the district court held that a clickwrap contract entered into by high school students (who were minors) was binding because while a contract entered into by a minor is voidable under state law, the students received benefit under the agreement and therefore they were barred from modifying the agreement or rendering it void.

142 *Pollstar v Gigmania Ltd*, 170 . Supp (2d) 974, 981 (ED Cal 2000), *Hines v Overstock.com Inc*, 668 F Supp (2d) 362, 2009 WL 2876667 (EDNY 2009).

143 *Ingle v Circuit City Stores Inc*, 328 F(3d) 1165 (9th Cir 2003); *AEB & Associates Design Group, Inc. v Tonka Corp*, 853 F Supp 724, 732 (SDNY 1994) (Standardized electronic contracts may be invalidated if the terms and conditions are not within the reasonable expectations of the contracting party, or the terms and conditions are unduly oppressive, unconscionable or against public policy.)

144 It should be noted as well that the focus of this paper has been on IP issues. There are many other issues that are important to consider and that may be worth addressing in user agreements. These issues may include privacy, the management of legal liability, setting norms for participant conduct, and so on. Although consideration of these issues is beyond the scope of this paper, researchers should be aware of these issues and should take them into consideration. See, e.g: Bowser *et al*, *supra* note 58.

145 For more discussion on the motivations of citizen scientists, see M. Jordan Raddick, "Galaxy Zoo: Exploring the Motivations of Citizen Science Volunteers" (2010) 9 *Astronomy Education Review* 010103 and Yochai Benkler, *The Penguin and the Leviathan* (New York: Crown Publishing Group, 2011).

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The Commons Lab is supported by the Alfred P. Sloan Foundation.