No. 12-398

IN THE

Supreme Court of the United States

THE ASSOCIATION FOR MOLECULAR PATHOLOGY, ET AL.,

Petitioners,

v.

MYRIAD GENETICS, INC., ET AL.,

Respondents.

ON WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

BRIEF FOR *AMICI CURIAE* INTERNATIONAL CENTER FOR TECHNOLOGY ASSESSMENT, COUNCIL FOR RESPONSIBLE GENETICS, GREENPEACE, INDIGENOUS PEOPLES COUNCIL ON BIOCOLONIALISM, FRIENDS OF THE EARTH, AND CENTER FOR ENVIRONMENTAL HEALTH IN SUPPORT OF PETITIONERS

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INTERESTS OF *AMICI CURIAE*[1]

Amici are public interest, non-profit organizations that oppose the patenting of genes because genes are products of nature. *Amici* seek to provide the Court with insight into the broader adverse effects of gene patents such as Respondent Myriad Genetics' Breast Cancer Susceptibility Genes 1 and 2 (collectively BRCA or BRCA1-2). These areas are central to *Amici*'s organizational missions and work, including gene patents' scientific, cultural, indigenous, and environmental impacts. These significant impacts can and should be avoided, because genes are not patentable subject matter.

Amicus **International Center for Technology Assessment (ICTA)** is a non-profit organization devoted to analyzing the economic, environmental, ethical, political, and social impacts that can result from the application of new technologies or technological systems. ICTA is jointly affiliated with the non-profits Center for Food Safety and Foundation Earth. ICTA's *PatentWatch* Project works to expose and challenge the inappropriate use of the U.S. patent system.

Amicus **Council for Responsible Genetics (CRG)** is a national non-profit organization dedicated to representing the public interest and

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[1] Petitioners have lodged a blanket consent to the filing of *amicus* briefs, and a letter of consent to the filing of this brief by Respondents has been lodged with the Clerk of the Court. No counsel for any party in this case authored this brief in whole or in part, and no person or entity other than *Amici Curiae* made a monetary contribution to its preparation or submission.

fostering public debate about the social, ethical, and environmental implications of genetic technologies. CRG's *Genetic Bill of Rights* outlines the fundamental values that have been put at risk by new applications of genetics and specifically opposes gene patents. CRG publishes *GeneWatch*, a periodical that regularly includes articles by experts in the field on issues related to gene patents.

Amicus **Greenpeace, Inc**. is the leading independent campaigning organization that uses peaceful direct action and creative communication to expose global environmental problems and to promote solutions that are essential to a green and peaceful future. Greenpeace's report, *The True Cost of Gene Patents*, details the severe economic and social consequences of patenting genes and living organisms.[2]

Amicus **Indigenous Peoples Council on Biocolonialism (IPCB)** is a non-profit Indigenous peoples' organization that seeks to protect the Indigenous knowledge, cultural heritage, and genetic materials of Indigenous peoples. IPCB monitors and evaluates the complex linkages between biotechnology, intellectual property rights, and the forces of globalization in relation to Indigenous peoples' rights and concerns.

Amicus **Friends of the Earth (FoE)** is a non-profit organization founded in 1969 and its mission is to defend the environment and champion

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[2] Greenpeace, Inc., *The True Cost of Gene Patents*, June 15, 2004, *available at* http://www.greenpeace.org/international/en/publications/reports/the-true-cost-of-gene-patents/ (last visited Jan. 29, 2013).

a healthy and just world. FoE's campaigns focus on promoting clean energy and solutions to climate change, keeping toxic and risky technologies out of the food we eat and products we use, and protecting marine ecosystems and the people who live and work near them.

Amicus **Center for Environmental Health (CEH)** is a non-profit organization dedicated to protecting the public from environmental and public health hazards. CEH is committed to environmental justice, promoting a safe and sustainable food supply, supporting communities in their quest for a safer environment, and fostering corporate accountability.

SUMMARY OF ARGUMENT

Respondent Myriad Genetics' patents are contrary to one hundred and fifty years of precedent in which this Court has held that the products and laws of nature are not patentable subject matter. Gene sequences, DNA, and cDNA are products of nature. Genes also embody laws of nature, because they are quintessentially information, in the form of DNA. Myriad did not invent the patented DNA, nor its useful characteristics or functions. Myriad's extraction of the patented genes from the body (isolation) does not alter that conclusion.

Petitioners and several other *Amici* comprehensively detail how gene patents impede crucial research and interfere with medical care, to the detriment of patients, doctors, non-profit organizations, and researchers. Yet, as serious as these harms are, there are unfortunately further

significant scientific, cultural, and environmental impacts flowing from these patents.

First, privatizing genes creates rights of unknown scope and significance, because science currently lacks a holistic understanding of their roles vis-à-vis non-hereditary proteins, other DNA sequences that are not genes, RNA, the cellular environment, and the extra-human environment. Recent scientific research fatally belies prior assumptions of the gene as the *sine qua non* of biology and heredity, and instead reveals a more complex and nuanced relationship and role of DNA in the body. The patenting of one biological "building block" in this epigenetic dynamic hampers scientific advancement, a result that is antithetical to the basic purpose of patent law.

Second, because genes are fundamentally encoded storehouses of information, gene patents deny the public access to natural genetic data, in contravention of the public good. These patents violate fundamental common law precepts of common heritage, the public domain, and the public trust.

Finally, gene patents privatize genetic ancestry, making Indigenous peoples and medical patients into "treasure troves" to be exploited for economic gain, in violation of cultural and religious values, and basic rights to informed consent.

For these reasons, *Amici* request the Court reverse the Federal Circuit and hold the patent claims invalid.

ARGUMENT

I. GENES ARE NOT PATENTABLE SUBJECT MATTER

For more than a century and a half, this Court has held that the laws and phenomena of nature are not patentable, as required by Article I, Section 8, Clause 8 of the U.S. Constitution (the patent clause of the U.S. Constitution), as well as 35 U.S.C. § 101 (the patent statute subject matter requirements). *See, e.g.*, *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980); *Funk Bros. Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127, 130 (1948); *Am. Wood-Paper Co. v. Fibre Disintegrating Co.*, 90 U.S. 566, 593-94 (1874); *see also J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc.*, 534 U.S. 124, 130, 134 (2001); *Diamond v. Diehr*, 450 U.S. 175, 185 (1981); *Parker v. Flook*, 437 U.S. 584, 593 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 67 (1972); *O'Reilly v. Morse*, 56 U.S. (15 How.) 62, 112-121 (1854); *Le Roy v. Tatham*, 55 U.S. (14 How.) 156, 175 (1853). The Court has recently twice reaffirmed this doctrine. *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 132 S. Ct. 1289, 1293-94 (2012); *Bilski v. Kappos*, 130 S. Ct. 3218, 3225 (2010).

Natural laws and phenomena are "nature's handiwork," *Chakrabarty*, 447 U.S. at 310, "the basic tools of scientific and technological work," *Gottschalk*, 409 U.S. at 67. As such, the doctrine establishes a "bright-line prohibition against patenting laws of nature" which also serves as a "proxy for the underlying 'building block' concern." *Mayo*, 132 S. Ct. at 1303. Hence "patents cannot issue for the discovery of the phenomena of nature,"

which are "part of the storehouse of knowledge of all men. They are manifestations of laws of nature, free to all men and reserved exclusively to none." *Funk Bros.*, 333 U.S. at 130 (citing *Le Roy*, 55 U.S. (14 How.) at 175); *accord Bilski*, 130 S. Ct. at 3225; *Chakrabarty*, 447 U.S. at 309.

Permitting the patenting of these indispensable building blocks is contrary to the fundamental purposes of patent law, because it would "monopoliz[e]" those "basic tools of scientific and technological work," "impede innovation more than . . . promote it," *Mayo*, 132 S. Ct. at 1293, and "risk disproportionately tying up the use of the underlying natural laws, inhibiting their use in making further discoveries," *id.* at 1294.

Applying the doctrine to the question presented, the answer is plain: genes, specifically here Myriad's patented BRCA genes, are not patentable. There is no "invention" here. *Chakrabarty*, 447 U.S. at 309. In contrast to "products of nature," "human-made inventions" based upon them are to be "markedly different." *Id.* at 310, 313. The patented genes are a far cry from being "markedly different" than what occurs in nature; they are identical. If a "new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter," than neither is a new gene discovered in the body. *Mayo*, 132 S. Ct. at 1293 (quoting *Chakrabarty*, 447 U.S. at 309).

A substance whose characteristics and function are indistinguishable from those of its naturally-occurring counterpart cannot constitute patentable subject matter. *Funk Bros.*, 333 U.S. at 130-31. In

Funk Brothers, the Court held that certain root nodule bacteria mixtures used to inoculate plant seeds were not patentable because "[e]ach species has the same effect it always had . . . Their use in combination does not improve in any way their natural functioning. They serve the ends nature originally provided and act quite independently of any effort of the patentee." *Id.* at 131 (emphases added).[3] The same is true here: the structure and function of genes are created by nature. The patented gene sequences here serve the ends nature originally provided and act independently of any effort of Respondents.

Nor does the fact Respondents "isolated" the genes matter. Isolation is a not an "inventive concept." *Mayo*, 132 S. Ct. at 1294, 1297; *see also Aventis Pharma Deutschland GmbH v. Lupin, Ltd.*, 499 F.3d 1293, 1302 (Fed. Cir. 2007) ("[I]solation of interesting compounds . . . 'is likely the product not of innovation but of ordinary skill and common sense.'") (quoting *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007)). The mere removal of a product of nature from its natural environment is insufficient to confer inventive status. *Am. Wood-Paper Co.*, 90 U.S. at 593-94 ("A process to [extract something] from a subject from which it has never been taken may be the creature of invention, but the thing itself

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[3] *See also Am. Wood Paper Co.*, 90 U.S. at 593-94 (cellulose derived from wood pulp by a new process not patentable because it was indistinguishable from cellulose previously obtained from other sources via existing processes); *Cochrane v. Badische Anilin & Soda Fabrik*, 111 U.S. 293, 311 (1884) (holding artificial alizarine (a dye) derived from a new process unpatentable because the claimed product was indistinguishable from that obtained naturally).

when obtained cannot be called a new manufacture."). Diverting (also known as "isolating") water from a river, or plucking (also known as "isolating") a leaf from a tree or a feather from a bird, do not make those substances patentable. *See, e.g.*, *Ex parte Latimer*, 1889 Dec. Comm'r Pat. 123, 125-126 (1889) (rejecting claim for "purified pine needle fiber"); *Gen. Elec. Co. v. DeForest Radio Co.*, 28 F.2d 641, 643 (3d Cir. 1928) (rejecting claim for "pure tungsten"), *cert. denied* 278 U.S. 656 (1929); *In re Marden*, 47 F.2d 958, 959 (C.C.P.A. 1931) (rejecting claim for "pure vanadium"). The gene, once isolated, is not subsequently "markedly different" in either structure or function. *Chakrabarty*, 447 U.S. at 310.

The patented substances are also not eligible subject matter because genes, as the carriers of DNA, are the physical embodiment of laws of nature. *See Funk Bros.*, 333 U.S. at 130 (products of nature are "manifestations of laws of nature, free to all men and reserved exclusively to none"). Gene sequences are not the same as conventional chemical substances. Rather, they are fundamentally information—an informational molecule embodying the genetic code. The patented genetic sequences' importance stems from their ability to encode and transmit this information, as instructions to the body. As such, this natural-law–natural-phenomena relationship is analogous to the *Mayo* Court's teaching that the prohibition on patenting laws of nature is a "proxy" for the "underlying building block." 132 S. Ct. at 1303 (quotations omitted).

Here, the information transmitted by the gene is identical, whether inside or outside the body. The useful properties of a gene are not ones that a

scientist has invented (or created through isolation), but rather are the natural, inherent properties of genes themselves. *Funk Bros.*, 333 U.S. at 130-31. Mere "isolation" of natural phenomena, particularly ones that are the literal "manifestation" of natural laws, cannot create patentable subject matter. As in *Mayo*, "simply appending conventional steps" to "laws of nature" or "natural phenomena" "cannot make those laws, phenomena, and ideas patentable." 132 S. Ct. at 1300; *accord Parker*, 437 U.S. at 590.[4]

II. GENE PATENTS ARE PROPERLY EXCLUDED FROM PATENTABLE SUBJECT MATTER BECAUSE THEY HAVE SIGNIFICANT NEGATIVE SCIENTIFIC, SOCIAL, CULTURAL, AND ENVIRONMENTAL CONSEQUENCES

In *Mayo*, this Court reiterated why it is essential not to have patents on products of nature or laws of nature:

> "Phenomena of nature, though just discovered, mental processes, and abstract intellectual concepts are not patentable, as they are the

[4] The Court need not reach the issue of cDNA, since Myriad's patents extend far beyond it; however if it does, the analysis is the same. cDNA's structure and function is created by nature, and it is not different when isolated. *Ass'n for Molecular Pathology v. USPTO*, 702 F. Supp. 2d 181, 198 (S.D.N.Y. 2010) ("[N]aturally occurring cDNAs, known as 'psuedogenes,' exist in the human genome and are structurally, functionally, and chemically identical to cDNAs made in the laboratory."). Permitting the patenting of cDNA would have the same negative impact of preempting basic scientific building blocks, and hampering future scientific progress.

> basic tools of scientific and technological work." And monopolization of those tools through the grant of a patent might tend to impede innovation more than it would tend to promote it.

132 S. Ct. at 1293 (quoting *Gottschalk*, 409 U.S. at 67); *see also Lab. Corp. of Am. Holdings v. Metabolite Labs., Inc.*, 548 U.S. 124, 126-27 (2006) (Breyer, J., dissenting), *dismissing cert. granted to* 370 F.3d 1354 (Fed. Cir. 2004) ("Rather, the reason for the exclusion is that sometimes too much patent protection can impede rather than 'promote the Progress of Science and useful Arts,' the constitutional objective of patent and copyright protection.") (emphasis in original) (quoting U.S. Const. art. I, § 8, cl. 8).

Recent scientific advances have undermined prior assumptions of the gene's role, and instead revealed a much more complicated and nuanced relationship between the DNA and the human body. Privatizing these building blocks of a larger systemic and not-yet-understood field further impedes the progress of science. The privatization of genetic heritage also violates fundamental common law precepts of common heritage, the public domain, and the public trust. Finally, the granting of gene patents creates a system where people are reduced to "treasure troves" to be mined for private economic gain, violating the fundamental rights of indigenous peoples as well as patients.

A. Gene Patents Privatize Genetic Information of Which Scientists Lack a Full Understanding, Creating Rights of Unknown Scope and Significance, and Consequently Retarding, Rather than Furthering, the Progress of Science.

Gene sequences are not akin to a conventional chemical substance or a drug; they are instead fundamentally information, an informational molecule embodying the genetic code. The patent for a particular gene sequence patents the information contained in the sequence—for example, the As, Ts, Cs, and Gs of the genetic code. *See, e.g.*, Sunny Bains, *Double Helix Doubles as Engineer*, 279 Sci. 2043, 2043-44 (1998) (detailing the four bases making up DNA: cytosine, guanine, adenine, and thymine). The tens of thousands of genes in our bodies are involved in the production of over one-hundred thousand biological proteins. *See, e.g.*, Alan E. Guttmacher & Francis S. Collins, *Genomic Medicine—A Primer*, 347 New Eng. J. Med. 1512, 1514 (2002). The patent holder that purports to describe one commercial use should not then have a monopoly on all possible functions, particularly given that each commercial use covers only a small amount of what the patented gene does. *Funk Bros.*, 333 U.S. at 132 ("[W]e cannot so hold without allowing a patent to issue on one of the ancient secrets of nature now disclosed.").

More fundamentally, genes are substances that we still know little about, and about which scientific views have recently evolved significantly. *See, e.g.*, Carl Zimmer, *Now: The Rest of the Genome*, N.Y. Times, Nov. 11, 2008, at D1 (discussing the current

gene "identity crisis" and how "new large-scale studies of DNA are causing [scientists] to rethink the very nature of genes"); Christopher Chabris et al., *Most Reported Genetic Associations with General Intelligence Are Probably False Positives*, 23 Psychol. Sci. 1314, 1314-23 (2012); Brendan Maher, *Personal Genomes: The Case of the Missing Hereditability*, 456 Nature 18, 18-21 (2008). Our evolving knowledge of human genes makes it imperative that such fundamental building blocks remain in the public domain.

For example, it was long believed that, because of the complexity of the human organism, people would have significantly more genes than other life forms, with estimates between one and two hundred thousand genes. The surprising results of the 2001 Human Genome Project show that humans actually have only about twenty thousand genes, a similar count to worms, flies, and yeast. *See*, *e.g.*, Elizabeth Pennisi, *Working the (Gene Count) Numbers: Finally, a Firm Answer?*, 316 Sci. 1113 (2007); *The Human Microbiome: Me, Myself, Us*, Economist, Aug. 18, 2012 (noting that humans have twenty-three thousand genes, dwarfed by the three million bacteria genes in each individual).

Instead, we now know that very minor changes in an individual's DNA sequences (not just the sequences that make proteins) can cause significant differences between even individual humans. Gina Kolata, *Study Discovers Road Map of DNA; A Key to Biology*, N.Y. Times, Sept. 6, 2012, at A1 ("As scientists delved into the 'junk'—parts of the DNA that are not actual genes containing instructions for proteins—they discovered a complex system that

controls genes."); *id.* ("The human genome is packed with at least four million gene switches that reside in bits of DNA that once were dismissed as 'junk' but that turn out to play critical roles in controlling how cells, organs and other tissues behave. The discovery, considered a major medical and scientific breakthrough, has enormous implications for human health because many complex diseases appear to be caused by tiny changes in hundreds of gene switches."). As researchers discover more about these other human DNA components, the danger of gene patents halting further research and discovery is obvious. *Mayo*, 132 S. Ct. at 1294 (warning against the "danger" of claims "so abstract and sweeping as to cover both known and unknown uses" of the subject matter such that their use will "inhibit future innovation") (citing *Gottschalk*, 409 U.S. at 67-68); *O'Reilly*, 56 U.S. (15 How.) at 113 ("For aught that we now know some future inventor, in the onward march of science, may discover a mode of writing or printing . . . without using any part of the process or combination set forth in the plaintiff's specification . . . . But yet if it is covered by this patent the inventor could not use it, nor the public have the benefit of it.").

Hence, current research indicates that human complexity does not come primarily from genes, but instead must be related to other elements of our biology and the outer environment including: 1) the non-coding elements of DNA, so-called "junk" DNA accounting for more than 98% of all DNA, which is now seen to play a far more important role in regulating gene function than previously thought; 2) a cell's RNA often believed to be merely a "messenger" for genes, now understood to play a

more important part in heredity and the causation of hereditary disease; and 3) the identity and number of the many hundreds of thousands of proteins in a cell, which often have a controlling influence on the action of genes—these proteins are viewed as critical biological actors in heredity and incidence of cancer and other disease. The ENCODE Project Consortium, *Identification and Analysis of Functional Elements in 1% of the Human Genome by the ENCODE Pilot Project*, 447 Nature 799, 799-816 (2007); Kolata, *supra*, at A1 (discussing the 2012 publication of several dozen groundbreaking scientific articles on the ENCODE findings); *id.* ("Most of the changes that affect disease don't lie in the genes themselves; they lie in the switches.") (quoting Professor Michael Snyder of Stanford University); *see also* Rick Weiss, *Intricate Toiling Found in Nooks of DNA Once Believed to Stand Idle*, Wash. Post, June 14, 2007 (reporting "[t]he first concerted effort to understand all the inner workings of the DNA molecule is overturning a host of long-held assumptions about the nature of genes and their role in human health"); Elizabeth Pennisi, *Genomics: DNA Study Forces Rethink of What It Means to Be a Gene*, 316 Sci. 1556, 1556-57 (2007) (stating that the research reveals an extremely different picture of DNA, RNA, protein, and their interactions than the one that scientists have assumed for decades).

Environmental influences can also affect DNA. Oliver Burkeman, *Why Everything You've Been Told About Evolution Is Wrong,* Guardian, Mar. 18, 2010, at G2-6 ("Rather than genes simply 'offering up' a random smorgasbord of traits in each new generation, . . . it seems that the environment plays

a role in creating those traits in future generations."). New findings in the field of epigenetics show that environmental factors such as diet, stress, and prenatal nutrition can change genetic activity across at least one successive generation, even where genetic code may not be altered. John Cloud, *Why Your DNA Isn't Your Destiny*, Time, Jan. 6, 2010; *see also* Kara Rogers, *Epigenetics: A Turning Point in Our Understanding of Heredity*, Sci. Am., Jan. 16, 2012 ("This type of finding—an inherited difference that cannot be explained by variations in genes themselves—has become increasingly common, in part because scientists now know that genes are not the only authors of inheritance."); Laura Beil, *Medicine's New Epicenter? Epigenetics*, Cure (Winter 2008), http://www.curetoday.com/index.cfm/fuseaction/article.show/id/2/article_id/949 (last visited Jan. 29, 2013).

These new findings have critical impacts on our understanding of BRCA1-2. First, no researcher claims that the patented genes "cause" breast cancer. There appears to be a statistical "association" between incidences of hereditary breast cancer and these genes.[5] Since both genes are believed to be related to tumor suppression, this may account for the percentage association with breast cancer; however the mechanism by which such tumor suppression is accomplished remains a mystery, as

[5] According to the National Institute of Health (NIH), in certain American populations BRCA1-2 mutations relate to 5–10% of all breast cancer and 10–15% of ovarian cancer. Nat'l Cancer Inst., NIH, *BRCA1 and BRCA2: Cancer Risk and Genetic Testing*, http://www.cancer.gov/cancertopics/factsheet/Risk/BRCA (last visited Jan. 29, 2013).

do the gene "defects" that contribute to breast cancer risk. Not surprisingly given this lack of scientific understanding, virtually all studies reporting this association of BRCA1-2 with incidences of hereditary breast cancer have called for more research to verify the extent of the association and its actual biological basis. *See*, *e.g.*, Andrea Veronesi et al., *Familial Breast Cancer: Characteristics and Outcomes of BRCA 1-2 Positive and Negative Cases,* 5 BMC Cancer 70 (2005); Hannaleena Eerola et al., *Survival of Breast Cancer Patients in BRCA1, BRCA2, and NON-BRCA1/2 Breast Cancer Families: A Relative Survival Analysis from Finland*, 93 Int'l J. of Cancer 368, 368-72 (2001); Mario Budroni et al., *Role of BRCA2 Mutation Status on Overall Survival Among Breast Cancer Patients from Sardinia*, 9 BMC Cancer 62 (2009); Mahmond El-Tamer et al., *Survival and Recurrence After Breast Cancer in BRCA 1/2 Mutation Carriers,* 11 Annals of Surgical Oncology 157, 157-64 (2004); Colin B. Begg et al., *Variation of Breast Cancer Risk Among BRCA1/2 Carriers*, 299 JAMA 194, 194-201 (2008); Mary-Claire King et al., *Breast and Ovarian Cancer Risks Due to Inherited Mutations in BRCA1 and BRCA2*, 302 Sci. 643, 643-46 (2003); A. Antoniou et al., *Average Risks of Breast and Ovarian Cancer Associated with BRCA1 or BRCA2 Mutations Detected in Case Series Unselected for Family History: A Combined Analysis of 22 Studies*, 72 Am. J. of Human Genetics 1117, 1117-30 (2003). A disclaimer on NIH's National Cancer Institute webpage states the problem plainly: "no data are available from long-term studies of the general population comparing cancer risk in women who have harmful *BRCA1* or *BRCA2* mutations with

women who do not have such mutations." Nat'l Cancer Inst., NIH, *supra* note 5 (emphasis added).

Adding to the confusion is a 2008 study demonstrating that high-risk women who did not have BRCA1-2 had a risk of new cancerous lesions considerably greater than those who were positive for the genes. Elizabeth Feldman et al., *The Incidence of Occult Malignancy and Atypical Histopathology in Prophylactic Mastectomy Specimens After Uninformative BRCA Testing*, 9 Am. Soc'y of Breast Surgeons Official Proc. 46 (2008), https://www.breastsurgeons.org/docs/ASBrS_Proceedings_2008.pdf (last visited Jan. 29, 2013). As with the association to cancer, these seemingly contradictory conclusions need further research to be better understood.

However, both beneficial testing and further research are stymied by gene patents. *See* Dep't of Health and Human Servs. (DHHS), *Gene Patents and Licensing Practices and Their Impact on Patient Access to Genetic Tests* 2 (Apr. 2010) ("[T]here is evidence to suggest that patents on genes discourage follow-on research. . . . [W]hen exclusive rights are successfully enforced, there is only one provider of a genetic test, such as in the case of genetic testing for breast cancer . . . ."); Heidi Williams, *Intellectual Property Rights and Innovation: Evidence from the Human Genome* (Nat'l Bureau of Econ. Research, Working Paper No. 16213, 2010) ("Taken together, these results suggest that Celera's [two-year intellectual property] had persistent negative effects on subsequent innovation relative to a counterfactual of Celera genes having always been in the public domain."); Robert Cook-Deegan et al., *The Dangers of*

Diagnostic Monopolies, 458 Nature 405, 405-06 (2009).

In sum, our emerging understanding of the role that genes and the other biological elements play in the cell, and how the environment influences those elements, indicates that the old, mechanistic, and overly-simplistic view of genes "causing" complex diseases such as cancer are simply wrong. Research now shows that many cancer cells have no genetic mutations at all. *See, e.g.*, Beil, *supra*. Instead, it is now understood that many human diseases are caused by complex dynamics between non-hereditary proteins, DNA, RNA, the cellular environment, and the extra-human environment. For example, some serious inherited diseases are likely caused by inherited bacteria, which interact with human genes in ways that are scarcely understood today. Economist, *supra*. Thus by allowing the patenting of one product of nature's "building blocks" in this overall process, research into this complex and dynamic process is halted. DHHS, *supra*, at 3 ("[P]atents on genes and associations threaten the development of new and promising testing technologies . . . . These concerns are more than hypothetical. Patents are already hindering the development of multiplex tests.").[6]

Just as billions of dollars of government research have shown the gene is not "the dictator" of heredity

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[6] *See also* DHHS, *supra*, at 2 ("Moreover, patents on genes are not needed to stimulate the disclosure of research discoveries. . . . [DHHS's expert committee] found no cases in which possession of exclusive rights was necessary for the development of a particular genetic test . . . .").

and hereditary diseases, patents on genes such as the BRCA1-2 halt the progress of this new scientific paradigm; they halt the investigation of how these DNA sequences interact with other biological elements, which may be far more important than the genes with regard to disease creation. *See Mayo*, 132 S. Ct. at 1294 (in determining Section 101 eligibility, considering whether the patents risk "disproportionately tying up the use of the underlying natural laws, inhibiting their use in making further discoveries"); *id.* at 1301 ("The Court has repeatedly emphasized this last mentioned concern, a concern that patent law not inhibit further discovery by improperly tying up the future use of laws of nature."). Halting science's critical march into a more comprehensive understanding of disease causation, and nature more broadly, is flatly contrary to patent law's basic purpose, to "promote the Progress of Science and useful Arts." U.S. Const. art. I, § 8, cl. 8; *Chakrabarty*, 447 U.S. at 307, 315.

B. The Privatization of Genetic Heritage Violates the Fundamental Common Law Precepts of Common Heritage, the Public Domain, and the Public Trust.

The genetic building blocks of life and its elements are the common heritage of humanity, available to all to learn from and utilize. Gene patents are antithetical to the tenets of common heritage, the public domain, and the public trust. As naturally-occurring resources that are central to human identity and survival, genes are part of the common heritage of humanity and should be held as part of the public trust, owned by all people, not granted to a single firm to the exclusion of all others.

Patents should not be granted for genes because genes are *res communis*, the common heritage and inheritance of mankind. The information that genes embody is "part of the storehouse of knowledge of all men." *Funk Bros.*, 333 U.S. at 130. Pursuant to the common heritage theory, public resources such as genes are available for use by all without restriction, for the benefit of humanity. U.N. Educ., Scientific and Cultural Org., Universal Declaration on the Human Genome and Human Rights, 29th Sess., 29C/Res. 19, at art. 12(a) (Nov. 11, 1997) ("Benefits from advances in biology, genetics and medicine, concerning the human genome, shall be made available to all, with due regard for the dignity and human rights of each individual."); *see also* Linda J. Demaine & Aaron Xavier Fellmeth, *Reinventing the Double Helix: A Novel and Nonobvious Reconceptualization of the Biotechnology Patent*, 55 Stan. L. Rev. 303, 442 (Nov. 2002) ("Scores of eminent scientists and many foreign governments have taken the position that the human genome . . . [is] the common heritage and inheritance of mankind . . . ."); Pilar N. Ossorio, *The Human Genome as Common Heritage: Common Sense or Legal Nonsense*?, 35 J.L. Med. & Ethics 425, 426-30 (2007); Melissa L. Sturges, *Who Should Hold Property Rights to the Human Genome? An Application of the Common Heritage of Humankind*, 13 Am. U. Int'l L. Rev. 219, 245-52 (1997); Barbara Looney, *Should Genes Be Patented? The Gene Patenting Controversy: Ethical and Policy Foundations of an International Agreement*, 26 Law & Pol'y Int'l Bus. 231, 231-72 (1994); Hubert Curien, *The Human Genome Project and Patents*, 254 Sci. 1710, 1710-12 (1991).

The common heritage doctrine has been applied in many other areas, to a variety of resources, including the sea floor, activities in outer space, the use of seeds, preservation of historical artifacts, and the conservation of environmental resources. *See, e.g.*, Kernal Baslar, *The Concept of the Common Heritage of Mankind in International Law* 31-37, 108-109 (1998); Andrew Chin, *Research in the Shadow of DNA Patents*, 87 J. Pat. & Trademark Official Soc'y 846, 864 (Nov. 2005); *see also* Emmanuel Aguis, *Germ-Line Cells—Our Responsibilities for Future Generations* 133-143 (Salvino Busuttil ed., 1990) ("If there is an obvious component of the common heritage of mankind, indeed, more obvious than the resources of the sea-bed itself, it is the human genetic system.").[7]

Similarly, the importance of the public domain is recognized in patent law by the exclusion of the laws of nature, natural phenomena, and abstract ideas from patent eligibility. *Mayo*, 132 S. Ct. at 1293. This Court has long held that existing knowledge and materials that exist in the public domain are not to be patented: "Congress may not authorize the issuance of patents whose effects are to remove existent knowledge from the public domain, or to restrict free access to materials already available." *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 6 (1966); *see also Bonito Boats, Inc. v. Thunder*

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[7] Because of the unique legal status of indigenous peoples and their rights to their genetic material, *see infra*, the doctrine of common heritage of mankind is not applicable to them. Accordingly, specific legislation and regulations are needed to reserve the right of indigenous peoples to determine whether or not they want to provide their genetic material for research purposes.

Craft Boats, Inc., 489 U.S. 141, 151 (1989) (explaining that "free exploitation of ideas will be the rule, to which the protection of a federal patent is the exception"); *Precision Instrument Mfg. Co. v. Auto. Maint. Mach. Co.*, 324 U.S. 806, 816 (1945) ("[A] patent is an exception to the general rule against monopolies . . . .").

"A patent by its very nature is affected with a public interest." *Precision Instrument*, 324 U.S. at 816. By preventing research and monopolizing genetic data, gene patents take information out of the public domain and impede the progress of science, contrary to the express intent of the Constitution. U.S. Const. art. I, § 8, cl. 8; *Mayo*, 132 S. Ct. at 1293 (warning against the "monopolization" of "basic tools of scientific and technological work" through patents); *In re Marden*, 47 F.2d at 959 (holding that "pure vanadium is not new in the inventive sense, and it being a product of nature, no one is entitled to a monopoly of the same").

Finally, the related concept of the public trust doctrine also illustrates why human genetics should be protected as public property. *See, e.g.*, Looney, *supra*. The public trust doctrine requires governments to hold property in trust for use by the general public, and maintain that property for certain types of public uses. *See generally* Joseph L. Sax, *The Public Trust Doctrine in Natural Resources Law: Effective Judicial Intervention,* 68 Mich. L. Rev. 471, 475-83, 485-89, 556-57 (1970). The conceptual underpinnings of the public trust doctrine are: that certain interests are so intrinsically important to every citizen that their free availability tends to mark the society as one of citizens rather than serfs;

that certain benefits derive so directly and particularly from nature that they should be available to the entirety of a populace; and that certain uses of property have value only to the extent that they are public. *Id*. As such, the public trust doctrine should apply here to cover genes, because genes are of intrinsic importance to all people and their benefits flow directly from human biology, the value of which is severely negated if not public. *See, e.g.*, Ossorio, *supra,* at 427.[8]

Accordingly, human genetic information should remain in the public domain, held in public trust, in order to prevent the monopolization of our common heritage.

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[8] In addition to violating basic rights common to humanity, gene patents cause the underutilization of genetic material. The proliferation of intellectual property rights on original genetic material may stifle life-saving innovations downstream from product research and development, a phenomenon known as "the tragedy of the anticommons." *See, e.g.*, Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 Sci. 698, 698-701 (1998) (citing Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 Harv. L. Rev. 621, 621-88 (1998)); Chin, *supra*, at 878-79. If the right of companies to exclude others from use of genetics continues and expands, all genetic resources will become increasingly underutilized, reducing the benefit of these resources to humanity.

C. Gene Patents Facilitate the Exploitation of Indigenous Peoples and Violate International Law.

Genes are fundamentally storehouses of information that have been passed down to each person from his or her ancestors, and that will be passed down to his or her children. For Indigenous groups, their genetic materials hold traditional, cultural, and spiritual significance. *See, e.g.,* Debra Harry & Le'a Malia Kanehe, *Asserting Tribal Sovereignty Over Cultural Property: Moving Towards Protection of Genetic Material and Indigenous Knowledge*, 5 Seattle J. for Soc. Just. 27, 32-33 (2006) ("Several Indigenous peoples recognize an inherent sacredness in DNA.").

The legality of gene patents has caused some to view Indigenous peoples as "treasure troves." Researchers have applied for patents based on cell lines derived from Indigenous people without their consent, such as the Guyami of Panama, the Hagahai of Papua New Guinea, and the Melanese of the Solomon Islands. *See, e.g.*, Debra Harry, *Indigenous Peoples and Gene Disputes*, 84 Chi.-Kent L. Rev. 147, 179-182 (2009). Indigenous communities are attractive to genetic researchers for several reasons, including: 1) they are perceived to be more genetically homogenous than other populations, making it easier for researchers to find links between specific diseases and genetic sequences; and 2) they often have high rates of specific diseases such as type II diabetes, heart disease, cancers, and arthritis. *See, e.g.*, Rebecca Tsosie, *Cultural Challenges to Biotechnology: Native American Genetic Resources and the Concept of*

Cultural Harm, 35 J.L. Med. & Ethics 396, 396, 405 (2007).

The legal battle between members of the Havasupai Tribe and Arizona State University demonstrates the research interests in Indigenous peoples' genes, and the failure of the current legal and ethical framework to respect the significance of such materials to Indigenous peoples. Members of the Havasupai, a tribe from an isolated region of the Grand Canyon in Arizona, were sought as research subjects to study the possibility of a genetic basis for the prevalence of type II diabetes within the Tribe. Although the Tribe and some members consented to diabetes-related research at Arizona State University, their blood samples were used for other purposes—including inbreeding, schizophrenia, and ancient migration theories—and also transferred to other universities, all without their consent. *See*, *e.g.*, Katherine Drabiak-Syed, *Lessons from Havasupai Tribe v. Arizona State University Board of Regents: Recognizing Group, Cultural, and Dignitary Harms as Legitimate Risks Warranting Integration into Research Practice*, 6 J. Health & Biomed. L. 175, 175-86 (2010). The Tribe and individual members maintained that the defendant university and researchers "violated the Havasupai Tribe's and tribal members' cultural, religious, and legal rights and have caused the Havasupai Tribe and its members severe emotional distress." *Havasupai Tribe v. Ariz. Bd. of Regents*, 204 P.3d 1063, 1069 (Ariz. Ct. App. 2008), *appeal denied*, 2009 Ariz. LEXIS 82 (Apr. 20, 2009). The parties ultimately settled, requiring the defendants to return all of the Tribe's genetic materials as well as terminate any ongoing or new research using the

Tribe's genetic materials. *See* Drabiak-Syed, *supra*, at 195.

This type of genetic research on Indigenous peoples often results in patents. For example, the U.S. Patent and Trademark Office granted the NIH and DHHS a patent on a human T-cell line obtained from a Hagahai man, a member of an isolated tribe of Papua New Guinea, without his consent. Harry, *supra*, at 180; *see also* U.S. Patent No. 5,397,696 (issued Mar. 14, 1995). NIH eventually forfeited its patent rights, but only after an international uproar. *See, e.g.*, Gary Taubes, *Scientists Attacked for "Patenting" Pacific Tribe*, 270 Sci. 1112, 1112 (1995); Sally Lehrman, *U.S. Drops Patent Claim to Hagahai Cell Line*, 384 Nature 500, 500 (1996); Eric L. Kwa, *In the Wake of the Hagahai Patent: Policy and Legal Development on Gene Ownership and Technology*, *in Pacific Genes & Life Patents* (Aroha Te Pareake Mead & Steven Ratuva eds., United Nations Univ. Inst. of Advanced Studies 2007).

The "Guayami patent" is another example. In that case the U.S. Department of Commerce filed a patent application for "Human T-Lymphotropic Virus Type II from Guayami Indians in Panama," even though neither the tribe nor the woman whose genetic sequence was at issue knew anything about the development of the cell line or the patent application. *See, e.g.*, Marina L. Whelan, *What, If Any, Are the Ethical Obligations of the U.S. Patent Office? A Closer Look at the Biological Sampling of Indigenous Groups*, 2006 Duke L. & Tech. Rev. 14, 13-15 (2006). The President of the Guayami General Congress wrote the U.S. Secretary of Commerce, demanding that the application be withdrawn

because it was made without consultation or consent and because the patent was "not an invention but rather a discovery of an antibody which is part of the blood of a Guayami woman." *Id.* As a result of this protest from the Guayami people as well as from numerous public interest groups, the patent was withdrawn. *Id.*

Although the U.S. government elected to drop its patents on the Hagahai and Guayami genes due to public and diplomatic pressure, there was not any legal obligation to so act. Indigenous peoples remain vulnerable to similar patents on their genes, particularly following the 1980 passage of the Bayh-Dole Act, which encourages universities to patent inventions developed with federal funding. Patent and Trademark Law Amendments Act, Pub. L. No. 96-517 (1980) (codified as amended in scattered sections of 35 U.S.C.). This legislation has facilitated the entry of universities into the marketplace by giving them the right to patent and commercialize inventions, including human genes.

The United Nations Declaration on the Rights of Indigenous Peoples, adopted in 2007 by the U.N. General Assembly, recognizes that "Indigenous peoples have the right to maintain, control, protect and develop their cultural heritage, . . . including human and genetic resources . . . ." United Nations Declaration on the Rights of Indigenous Peoples, G.A. Res. 61/295, U.N. GAOR, 61st Sess., U.N. Doc. A/RES/61/295, at art. 31 (Sept. 13, 2007). This right stems from the central right of self-determination, which includes a right to autonomy or self-government in matters relating to internal or local affairs. *Id.* at art. 4. In the United States, this right

is embodied through the recognition and exercise of tribal sovereignty for federally-recognized tribes. *See* Tsosie, *supra*, at 401-09. While the proper utilization and disposition of genetic material associated with a tribe is an internal matter, there is no requirement in federal law to protect this right. *Id.* at 408 ("[L]egal categories of property rights and privacy rights inadequately address the claims being expressed by Native people with respect to human remains, bodily materials, and the intangible components associated with study or research that generates information and knowledge about these remains and materials.").

The U.N. Declaration also recognizes the obligation upon States to obtain the free, prior, and informed consent (FPIC) of indigenous peoples when legislative or administrative actions may affect them, as well as prior to the extraction of their resources. G.A. Res. 61/295 at arts. 19 & 32.[9] Given the demonstrated history of exploitation of Indigenous peoples' genetic material without their informed consent, any extension of patent protection to genes obtained from Indigenous peoples without their FPIC is an infringement of their internationally-recognized rights.

Hence, properly excluding gene sequences as impermissible subject matter pursuant to the product of nature doctrine would serve to protect the

[9] This principle of international law is closely related to the rights of individual human research subjects and patients to informed consent under federal law, except that FPIC is a right uniquely applicable to Indigenous peoples as collective groups, rather than as individuals.

rights of Indigenous peoples under international and federal law that are currently being violated.

D. Gene Patents Facilitate the Violation of Patients' Rights to Informed Consent.

Finally, the pernicious practice of granting gene patents facilitates the violation of basic notions of informed consent. Genetic research is being undertaken on people without their consent, as researchers prospect for genes.[10] Informed consent requires disclosure of all the information that is material to a patient's intelligent and informed decision. *See, e.g.*, *Johnson v. Kokemoor*, 545 N.W.2d 495, 501 (Wis. 1996). Justice Cardozo was one of the first to acknowledge the existence of a basic right to informed consent, concluding that "[e]very human being of adult years and sound mind has a right to determine what shall be done with his own body." *Schloendorff v. Soc'y of New York Hosp.*, 105 N.E. 92, 93 (N.Y. 1914), *overruled on other grounds by Bing v. Thunig*, 143 N.E.2d 3, 8 (N.Y. 1957). The concept is "fundamental in American jurisprudence." *Canterbury v. Spence*, 464 F.2d 772, 780 (D.C. Cir. 1972). Yet the patenting of genes allows private parties to own others' physical makeup without their consent or knowledge.

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[10] Press Release, U.N. Educ., Scientific and Cultural Org., Ethical Guidelines Urgently Needed For Collecting, Processing, Using and Storing Human Genetic Data, U.N. Press Release No. 2002-93 (Nov. 24, 2002), *available at* http://portal.unesco.org/en/ev.php-URL_ID=7791&URL_DO=DO_PRINTPAGE&URL_SECTION=201.html (last visited Jan. 29, 2013).

Researchers and health care institutions have litigated to gain ownership of patients' cell lines, tissue, and genes in order to commercialize them, over the patients' objections. *See, e.g.*, *Moore v. Regents of the Univ. of Cal.*, 793 P.2d 479 (Cal. 1990); *Wash. Univ. v. Catalona*, 490 F.3d 667 (8th Cir. 2007). In *Moore*, the seminal case regarding an individual's right to informed consent, the patient suffered from hairy-cell leukemia. 793 P.2d at 481. Before advising Moore that he needed to have his spleen removed, his physician decided that he would use Moore's spleen for research purposes. *Id.* The physician did not disclose his research intentions when he suggested Moore undergo surgery and later derived a cell line from Moore's T-lymphocytes, valued at $3 billion, over which the University of California applied for a patent. *Id*. Moore sued, arguing that he was unable to make an informed decision about whether to undergo his surgery because he was unaware of his physician's ulterior motives. *Id.* at 482. The California Supreme Court agreed, holding that "a physician must disclose personal interests unrelated to the patient's health, whether research or economic, that may affect the physician's professional judgment." *Id.* at 483. However the *Moore* decision has been limited to physicians and other individuals with whom a patient shares a fiduciary relationship—not to researchers and donors, even when the intent to patent and commercialize is not disclosed. *See Greenberg v. Miami Children's Hosp. Research Inst., Inc.*, 264 F. Supp. 2d 1064, 1067-68, 1070-71 (S.D. Fla. 2003) (distinguishing *Moore* in case in which a researcher patented the genetic sequence for Canavan disease after studying the blood and tissue samples of several donors).

NIH studies show that the public believes robust informed consent should be required. *See* Juli Murphy et al., *Public Perspectives on Informed Consent for Biobanking*, 99 Am. J. Public Health 2128, 2128-34 (2009). Yet the perverse incentives of gene patents weaken researcher commitment to openness. Leili Fatehi & Ralph Hall, *Enforcing the Right of Human Sources to Informed Consent and Disclosures of Incidental Findings from Biobanks and Researchers: State Mechanisms in Light of Broad Regulatory Failure*, 13 Minn. J. L. Sci. & Tech. 575, 579, 579 n.8, 581 (2012) (explaining the use of loopholes by DNA repositories "so that no obligations to human sources may exist").[11] The situation is exacerbated by a "broad regulatory failure" to protect informed consent requirements at a federal level, forcing states to take up the task. *Id.* at 582-84.[12] So long as genes remain patentable, litigation and uncertainty will flourish and multiply. *See id.* at 607-52 (discussing the many unanswered state and common law questions).

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[11] *See also Grimes v. Kennedy Krieger Inst.*, *Inc.*, 782 A.2d 807, 851 (Md. 2001) ("There is thus an inherent reason for not conveying information to subjects as it arises, that might cause the subjects to leave the research project. That conflict dictates a stronger reason for full and continuous disclosure.").

[12] *See* R. Hakimian et al., Nat'l Cancer Inst., NIH, *50-State Survey of Laws Regulating the Collection, Storage, and Use of Human Tissue Specimens and Associated Data for Research*, available at http://www.cancerdiagnosis.nci.nih.gov/humanSpecimens/survey/ (last visited Jan. 29, 2013); *see, e.g.*, *Bearder v. Minnesota*, 806 N.W.2d 766 (Minn. 2011) (holding that state agency's practice of collecting, using, storing, and disseminating children's blood samples and test results without obtaining written informed consent violated the state's Genetic Privacy Act).

CONCLUSION

For the foregoing reasons, the patent claims should be held invalid.

Respectfully submitted,

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