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A Theory of Genetic Dimensions in the Law

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Since the biotechnology revolution of the 1970s, genetic science and genetic technology have captured the public imagination. They have become a centerpiece of how we understand ourselves, our relationship with other humans, other living beings, our environment, and—indeed—with the universe. Through this evolution of understanding, genetic phenomena have acquired many meanings, some rooted in objective reality and others subjective and dependent on individual perceptions and sentiments.

However, legal decision-making and policymaking have not kept pace and reflect only a partial understanding of the multiple dimensions of genetic phenomena, which are forced into narrowing legal pathways, neglecting vital interests. As the legal uses of genetic technologies and disputes involving such technologies become increasingly prevalent, the disconnect between genetics and the law grows and deepens.

This Article identifies and analyzes the impact of the longstanding judicial and legislative practice of applying ill-fitting legal constructs to genetic phenomena. We use case studies drawn from various legal areas to show how forcing genetic phenomena into existing legal categories neglects important genetic interests.

The deficiencies of case law and legislation addressing genetics highlight the need for a more comprehensive way of thinking about, and legally recognizing, interests stemming from the multiple dimensions of genetic phenomena. In response, we provide a conceptual framework for incorporating genetic phenomena more fully into the law. Our approach offers legislators, judges, regulators, and lawyers a new way of thinking about genetics in the law, one that accounts for and accommodates the full range of individual, group, and societal interests in genetic phenomena.

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We are indebted to Paul Lombardo and Timothy Lytton for their outstanding support throughout this project; to Erin Fuse Brown, Pam Brannon, Meg Butler, Jorge Contreras, Russ Covey, Dov Fox, Caren Morrison, Susan Navarro Smelcer, Efthimios Parasidis, Anya Prince, Ryan Rowberry, Nirej Sekhon, Lauren Sudeall, Anne Tucker, Jeff Vagle, and Jack Williams; to the participants in the 2019 Wiet Life Science Law Scholars Workshop at Loyola University Chicago School of Law, Maryland Carey Law 2022 Summer Workshop, 2022 and 2023 Georgia State University College of Law Faculty Workshop, and Biolawpalooza 5.0 for helpful discussions and comments on earlier versions of this article; and last but not least, to Stephen Bradley, Rebecca Sohnlein, and Heather Sutton for their excellent assistance with the research for this article. Their invaluable insights and suggestions helped make this article immensely better than it would have been otherwise. All remaining mistakes are our own.
I. INTRODUCTION

Genetic phenomena do not fit neatly or comfortably into existing legal categories. Yet, existing legal approaches to genetics persist in forcing genetic phenomena into the narrowing confines of current legal doctrines. As a result, the

1. We use the term “genetic phenomena” to refer broadly to all kinds of genetic sequences. Later in this article, we propose “genetic objects” as a general term for genetic phenomena relevant in legal contexts. See infra note 11 and accompanying text and Part II.A.
law continuously fails to identify and accommodate vital individual, group, and societal interests attached to genetic phenomena. Consider the following examples.

Parents of children afflicted with an incurable genetic disease allow researchers to collect brain tissue from the bodies of their deceased children and blood samples from their dying children. Their decision to do so is not based on financial reasons, the attainment of public recognition, or even the hope of a cure for their own children. Rather, the parents know their children’s genetic material holds the key to developing a test and perhaps even treatment that would benefit others afflicted by the disease. They want to share that key with the researchers to achieve that goal. So, when the parents later find out that the researchers are using their discoveries to extract money from other families afflicted by the disease—the exact opposite of what the parents had intended—the parents sue. The judge, however, views the parents’ lawsuit as meritless and dismisses it. He believes the parents have no business meddling in how the researchers use their discoveries and feels that the parents’ sentiments surrounding the genetic samples are overblown and have no legal relevance.²

In another case, attorneys for cancer patients and the doctors who treat them struggle to explain their clients’ wishes to another court. Patients, doctors, and attorneys alike feel strongly that a person ought to be able to know and understand their genetic makeup, including their risk of cancer. They feel that a person’s genes are an integral part of who and what they are, and that no other person, entity, or patent should be allowed to prevent them from learning about that part of themselves. But expressing this intuitive notion in the language of the law proves difficult. While this judge is sympathetic, he too cannot work out how to breathe legal life into the patients’ and doctors’ intuitive claims. Eventually, he finds another, technical way to help them. The attorneys representing the patients and doctors declare victory. But the patients and their doctors know that although they have won this particular case, the idea of genetic access that drove them and animated their fight remains unvindicated.³

In a third case, a Supreme Court Justice has a tough choice to make. The matter before him involves a convicted felon whose lawyers are making lofty arguments about why the felon’s genetic materials should not be used to connect the felon with another, unsolved case involving a rape, from several years back. Without the genetic evidence, law enforcement is unlikely to ever solve the rape case, punish the perpetrator, and afford some closure for the victim. The felon’s attorneys make compelling arguments that genetic evidence is not the same as fingerprints and that allowing the government to collect genetic samples from arrestees would endanger every citizen’s freedom. The Justice’s colleagues on the lower court—and even some on his own Court—are receptive to these concerns. Yet without an established alternative, the Justice sees no reason to depart from this analogy. His opinion is succinct. Genetic evidence is just like fingerprints. The violent felon goes to prison.⁴

These stories are neither hypothetical nor unusual. Quite to the contrary. They are representative of what typically happens when lawmakers, policymakers, judges, and lawyers—a varied group we will call “jurists”—confront legal issues involving

². See infra Part IV.A.2.
³. See infra Part IV.B.
⁴. See infra Part IV.C.
The myopic treatment of genetic phenomena in legal matters is the result of jurists’ tendency to formulate legal solutions and draw analogies that focus only on narrow, specific aspects of the genetic phenomena they encounter. In doing so, jurists inevitably ignore and downplay other crucial aspects of such phenomena.

Although we have learned to accept the law’s imperfect grappling with complex, new technologies in other areas, in this article we show why genetic phenomena raise unique concerns deserving of tailored legal responses. We argue that the law—and the jurists who make and apply it—lack the tools to adequately respond to genetic phenomena with their many facets, complexities, and deep connections to core human values. This failure to “fit” genetics into the law is, we contend, partly a result of jurists’ natural inclination to box new phenomena into existing constructs and address such phenomena in the same way they address more familiar ones.

When confronted with new legal issues, jurists search existing legal frameworks to determine which best fits these issues and then try to “shape” the issue to the contours of the legal framework. That approach may work well in some, even most,

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5. We are conscious of the critique often leveled at calls for special (and specialized) legal treatment of narrowly defined subject matter categories—often ones driven by new or emerging technologies. Most famously see, for example, Frank H. Easterbrook, Cyberspace and the Law of the Horse, 1996 U. Chi. Legal F. 207 (1996). But see Lawrence Lessig, The Law of the Horse: What Cyberlaw Might Teach, 113 Harv. L. Rev. 501 (1999). In that vein, we are particularly cognizant of the “genetic exceptionalism” debate surrounding the need and justification for a specialized legal approach to genetic information. See, e.g., Lawrence O. Gostin & James G. Hodge, Genetic Privacy and the Law: An End to Genetics Exceptionalism, 40 Jurimetrics 21 (1999) (arguing that there is no clear demarcation between genetic data and other kinds of personal health data); Sonia M. Suter, The Allure and Peril of Genetic Exceptionalism: Do We Need Special Genetics Legislation?, 79 Wash. U. L.Q. 669 (2001) (arguing there is no clear separation between genetic information and other types of personal health information and that concerns about abuses of information are not limited to genetic information); George J. Annas, Genetic Privacy: There Ought to be a Law, 4 Tex. Rev. L. & Pol. 9, 9–14 (1999) (discussing “why we might see genetic information as special.”). An in-depth discussion of these debates is beyond the scope of this Article. We recognize there are similarities between the overarching arguments raised by proponents of specialized legal treatment and our arguments regarding a need for such treatment of genetic phenomena. Still, we contend the thesis we offer in this Article, as well as the examples from decades of legal (mal)treatment of genetic phenomena we bring, both illustrate the negative ramifications of ignoring and downplaying the unique, multidimensionality of genetic phenomena within the legal discourse and why specialized legal treatment of such phenomena is warranted. We further contend that the framework we propose in this article addresses most, if not all, of the concerns raised by detractors of specialized treatment.

6. This reality is, perhaps, surprising considering that legal scholars have been studying and describing the intersection between genetics and the law for many decades. See, e.g., Genetics and the Law (Aubrey Milunsky & George J. Annas eds., 1976); George P. Smith, II, Genetics, Ethics and the Law (1981); Law and Human Genetics: Regulating a Revolution (Roger Brownsword, W.R. Cornish & Margaret Llewelyn eds., 1998); Lori Andrews, Maxwell J. Mehlman & Mark A. Rothstein, Genetics: Ethics, Law, and Policy (2002).

7. See, e.g., Natalie Ram, DNA by the Entirety, 115 Colum. L. Rev. 873, 906–07 (2015) (suggesting that the law could address identifiable genetic information through a framework drawing from property law, intellectual property law, tort law, and business administration;
legal contexts, but it does not work for genetic phenomena, which fit poorly into existing legal frameworks. This is because genetic phenomena are, at the same time, chemical, functional, and informational entities. They are widely shared and intimately individual, partly fixed and partly everchanging, and they are rife with meanings that continue to evolve as our knowledge and understanding of genetic science broaden and deepen.

This Article proposes a new framework for accommodating the complexity of genetic phenomena and the richness of their meanings within legal decision-making and policy-making. The framework begins by defining “genetic objects” as the foundational unit of analysis of legal issues involving genetic phenomena. “Genetic objects” refers broadly to anything that consists of or contains a sequence of nucleotides—the building units of genetic material. Depending on the legal context, the genetic object may take on many different forms, such as a blood sample, a cheek swab, a hair caught on a hairbrush, a lost tooth, or even nasal mucus nestled in a used facial tissue.

Also suggesting that the law could better understand and address interests in familial DNA through the age-old property construct of tenancy by the entirety; Yaniv Heled & Liza Vertinsky, Genetic Paparazzi: Beyond Genetic Privacy, 82 OHIO ST. L.J. 409, 430–31 (2021) (suggesting that courts will most likely approach “genetic paparazzi scenarios” by utilizing privacy laws); Ayesha Rasheed, ‘Personal’ Property: Fourth Amendment Protection for Genetic Information, 23 U. PA. J. CONST. L. 547, 581, 587–91 (2021) (calling for recognizing a constitutional property right in genetic information under the Fourth Amendment); Albert E. Scherr, Genetic Privacy & the Fourth Amendment: Unregulated Surreptitious DNA Harvesting, 47 GA. L. REV. 445, 449 (2013) (offering “a model of an expectation of genetic privacy . . . that accounts for its physical, informational, and dignitary dimensions”).

8. For an explanation of these characteristics, see infra Part II.B.

9. For a recent example of how newly discovered genetic phenomena may have various significant ramifications, consider the recent report of a bone marrow recipient who began exhibiting the genetics of the donor in nonblood tissue, including his reproductive tissue, becoming what is known in genetic parlance as a “chimera.” Heather Murphy, When a DNA Test Says You’re a Younger Man, Who Lives 5,000 Miles Away, N.Y. TIMES, https://www.nytimes.com/2019/12/07/us/dna-bone-marrow-transplant-crime-lab.html [https://perma.cc/4PNT-G3PZ] (Dec. 12, 2019); see also infra Part IV.

10. See infra Part II.A and “Step 1” on p. 25.


12. See infra Part IV.E.1. For instance, in the first story above, the genetic objects were the children’s brain tissue and blood samples, and in the third story, it was the felon’s cheek swab. See supra text accompanying notes 2–4.

13. See Catherine Bennion-Pedley, They Paid What?! The 11 Craziest Celeb Items That Sold for £££s, SUN (June 8, 2016), https://www.thesun.co.uk/living/1248744/11-crazy-celeb-items-that-sold-for-a-fortune/ [https://perma.cc/XD29-58HN] (listing Scarlett Johansson’s tissue but also other items that could potentially contain genetic material originating from their owners such as John Lennon’s tooth, Jennifer Lawrence’s sports bra, William Shatner’s kidney stone, Britney Spears’s gum and pregnancy test, a jar of Brad Pitt and Angelina Jolie’s breath, Justin Bieber’s hair, Justin Timberlake’s toast, and Queen Elizabeth’s pants); see also Nicholas Graham, Obama’s Half-Eaten Breakfast Put Up for Sale on Ebay, HUFF. POST, https://www.huffpost.com/entry/obamas-half-eaten-breakfa_n_98300
After identifying the relevant genetic object, the framework then considers which of the multiple “dimensions” of the genetic object are implicated in the specific legal scenario. To facilitate this analysis, the framework provides a novel taxonomy of seven dimensions of genetic phenomena: (1) physical-chemical, (2) informational, (3) functional, (4) taxonomic, (5) group-identity-conferring, (6) individual-identity-conferring, and (7) reproductive. To illustrate, in the first story above, the judge overlooked the group-identity-conferring dimension of the genetic objects, which gave rise to the parents’ strong emotional connection with their children’s genetic objects and the larger community of families afflicted with the genetic mutation. In the second story, the judge failed to legally recognize the individual-identity-conferring dimension of the cancer patients’ genetic objects.

Next, our framework requires legal decision-makers to identify and explore the various interests implicated by the legal decision governing the disposition of the genetic object. To illustrate, the primary interest of the parents from the first story above was disseminating the fruits of the research broadly and freely in order to lower the frequency of the genetic disease in the general population. In the second story, the attorneys were struggling to articulate the cancer patients’ interest in freely accessing information about their own genetic objects. And in the third story, the Justice failed to consider or even mention in his opinion the interest of suspects’ families and larger genetic community in keeping their common genetic information out of the hands of the government.

Finally, our framework calls upon jurists to weigh the interests they have identified against each other in formulating a legal solution to the issue before them. The law is designed to balance competing interests, so once the broader array of interests attaching to a genetic object has been identified, it is possible to employ existing legal tools to incorporate these interests into legal decision-making.

Our framework provides jurists with a conceptual methodology that makes explicit the multi-dimensional nature of genetic phenomena and, in so doing, uncovers interests implicated within the relevant legal context in ways that can inform legal decision-making. Using the framework requires jurists to consider a broader range of interests implicated in matters involving genetic phenomena and thus allows them to avoid potential negative ramifications of legal tunnel vision.

[https://perma.cc/5HVK-EZRJ] (May 25, 2011) (describing an eBay listing for President Obama’s half-eaten breakfast and silverware with his DNA purportedly on it); Nicole Bode & Xana O’Neill, Authentic Britney Hair on Sale for $1 Million, SEATTLE TIMES (Feb. 19, 2007), https://www.seattletimes.com/nation-world/authentic-britney-hair-on-sale-for-1-million/ [https://perma.cc/N3FB-RKYQ] (describing an eBay listing of Britney Spears’s hair, a lighter, and drink that she left at the salon the night that she infamously shaved her head).

14. We use the term “dimensions” to denote certain aspects or characteristics of genetic phenomena.

15. For a fuller discussion of the different dimensions, see infra Part II.B and “Step 2” on p. 25.

16. See infra Part III.B and “Step 3” on p. 25.

17. See infra Part III.B and “Step 4” on p. 25.

18. Legal decision-making may occur in almost any legal context, including legislation and regulation, judicial decisions, law enforcement, regulatory compliance efforts, and attorneys’ legal advice.
Employing this framework in legal decision-making would thus allow the law to evolve apace with genetic science and technology.

The rest of the Article proceeds as follows. Part II offers a nomenclature designed to capture the multifaceted nature of genetic objects. Part III develops a framework for jurists to employ when considering legal issues involving genetic objects. The framework begins with the taxonomy of genetic dimensions from Part II and asks jurists to identify and balance the relevant stakeholder interests attached to these dimensions within a given legal context. This approach allows jurists to incorporate the full range of dimensions of genetics into legal decision-making. In Part IV, the Article relies on this approach to show how existing law falls short in its treatment of issues involving genetic phenomena and how our approach might do better. Drawing examples from property law, criminal law, intellectual property (IP) law, privacy law, and constitutional law, the Article analyzes significant legal decisions in cases involving genetic phenomena, such as Association for Molecular Pathology v. Myriad Genetics,19 Maryland v. King,20 Moore v. Regents of the University of California,21 Greenberg v. Miami Children’s Hospital Research Institute, Inc.,22 Ciccone v. Gotta Have It! Collectibles, Inc.,23 and Havasupai Tribe v. Arizona Board of Regents.24 The Article uses the framework outlined in Part III to show where and how these decisions fail to consider critical dimensions of the genetic objects at stake and to suggest how these cases might have been decided differently under our framework.

II. A NOMENCLATURE OF GENETIC DIMENSIONS

The rapid progress of genetic science and resulting genetic technologies in the past three-quarters of a century has been staggering. The discovery of the double-helix structure of DNA in the early 1950s25 has led to an explosion of further

19. 569 U.S. 576 (2013); see infra Part IV.B.
20. 567 U.S. 1301 (2012) (Roberts, C.J., in chambers); see infra Part IV.C.
21. 793 P.2d 479 (Cal. 1990); see infra Part IV.A.1.
22. 264 F. Supp. 2d 1064 (S.D. Fla. 2003); see infra Part IV.A.2.


33. Human Genome Project, NAT’L HUM. GENOME RSCH. INST.
clustered regularly interspaced short palindromic repeats (CRISPR) and the invention of CRISPR-Cas9 gene-editing technology; gene- and immuno-therapies, which are now used in the treatment of some of the most complex diseases; and the development and deployment of mRNA technology used in COVID-19 vaccines as well as other new drugs and treatments. These breakthroughs and their applications have affected every American and will continue to play significant societal roles for years to come.

The growing understanding of genetics and genetic technology’s increasing ubiquity in our lives has continuously shaped our understanding of ourselves, our relationships with other humans, creatures, and our world. In the process, genetic phenomena have acquired various meanings, some rooted in objective reality and others subjective and dependent on individual perceptions and sentiments. These developments have, in turn, resulted in mounting pressures on jurists to adapt the law to advances in genetics.

But jurists have struggled in their efforts to adapt the law to questions raised by genetic phenomena. This struggle has persisted even as genetic applications have become common currency in several legal contexts, including forensic identification, parenthood determinations, and the regulation of genetic research.

34. See Christine L. Xu & Stephen H. Tsang, The History of CRISPR: From Discovery to the Present, in CRISPR GENOME SURGERY IN STEM CELLS AND DISEASE TISSUES 1 (Stephen H. Tsang ed., 2021); Jon Cohen, How the Battle Lines over CRISPR were Drawn, SCIENCE (Feb. 15, 2017), https://www.science.org/content/article/how-battle-lines-over-crispr-were-drawn [https://perma.cc/AH9Q-K8YC].


37. See infra Parts II.B.5–8.


and development (R&D) efforts. And the adaptations of the law to genetics that jurists have come up with—whether through legislation, regulation, or judicial opinions—remain woefully incomplete. The Supreme Court’s recent decision in Dobbs has created yet another frontier in this struggle by deepening the disconnect between the limitations imposed by some states on reproductive freedoms and the multifaceted genetic interests of pregnant women and their children. Scholars have long recognized the limitations of existing legal frameworks for addressing genetic phenomena. Much of the debate surrounding recognizing legal


41. See, e.g., Leslie E. Wolf, Catherine M. Hammack, Erin Fuse Brown, Kathleen M. Brelsford & Laura M. Beskow, Protecting Participants in Genomic Research: Understanding the “Web of Protections” Afforded by Federal and State Law, 48 J.L. MED. & ETHICS 126, 134 (2020); Ellen Wright Clayton, Barbara J. Evans, James W. Hazel & Mark A. Rothstein, The Law of Genetic Privacy: Applications, Implications, and Limitations, 6 J.L. & BIOSCIENCES 1 (2019); Mark A. Rothstein, GINA at Ten and the Future of Genetic Nondiscrimination Law, 48 HASTINGS CTR. REP. 5, 5 (2018) [hereinafter Rothstein, GINA at Ten] (discussing GINA’s limitations on the definition of “genetic information” and narrow application only to health insurance and employment, allowing genetic discrimination to continue “in life insurance, disability insurance, long-term care insurance, mortgage insurance, educational opportunities, or commercial and real property transactions”); Anya E. R. Prince, Comprehensive Protection of Genetic Information: One Size Privacy or Property Models May Not Fit All, 79 BROOK. L. REV. 175 (2013) (reviewing the shortcomings of protections afforded to genetic information in U.S. legislation); NAOMI R. CAHN, TEST TUBE FAMILIES: WHY THE FERTILITY MARKET NEEDS LEGAL REGULATION 20–21 (2009); Mark A. Rothstein, Commentary, Putting the Genetic Information Nondiscrimination Act in Context, 10 GENETICS IN MED. 655, 656 (2008)[hereinafter Rothstein, GINA in Context] (detailing the confusing and possibly conflicting instruction of GINA and the Americans with Disabilities Act (ADA) regarding the release of genetic information); see also Julia Black, Regulation as Facilitation: Negotiating the Genetic Revolution, 61 MOD. L. REV. 621, 621 (1998) (acutely characterizing the regulation of genetic technology as a “mass of legal regulations, non-legal rules, codes, circulars, practice notes, international conventions, and ethical codes” produced by “an enormously complex set of advisory bodies, regulatory bodies, committees, professional bodies, and industry associations, operating in an international, national and sub-national level” and that the regulation itself “is not finding the right answers, or indeed asking the right questions”).

42. Dobbs v. Jackson Women’s Health Org., 597 U.S. ___, 142 S. Ct. 2228 (2022). Reproductive freedoms surrounding genetics are at even greater risk in light of views expressed in Justice Thomas’s concurring opinion. Id. at 2300 (Thomas, J., concurring) (calling into question the constitutional foundations of Griswold v. Connecticut, 381 U.S. 479 (1965)).

rights in genetic phenomena has revolved around adopting or rejecting existing property and privacy law constructs to capture interests in genetic phenomena within the law.\textsuperscript{44} The gravitation to property and privacy law concepts is understandable, given the salience of physical and informational dimensions of genetic phenomena and the availability of “ready-made” conceptual frameworks within privacy and property law for addressing these specific dimensions of genetic phenomena. But the current conceptual frameworks within property and privacy law are not equipped to capture the full range of dimensions of genetic phenomena.\textsuperscript{45}

To facilitate the development of these bodies of law—and, potentially, others—and to accommodate the full range of interests in genetic phenomena, we propose a generally retain an expectation of privacy against government surveillance in genetic information shared with third parties and that consent is required for third parties to share such information with law enforcement agencies); Mark A. Rothstein, \textit{Genetic Stalking and Voyeurism: A New Challenge to Privacy}, 57 U. KAN. L. REV. 539, 547–61 (2009) (examining the applicability of privacy law and property law causes of action to unauthorized collection and analysis of genetic objects); Ram, supra note 7, at 877 (arguing legal actors’ disregard of the interests of close genetic relatives in each other’s identifiable genetic information cannot persist and that “[i]f identifiable genetic information is worthy of protection, then legal institutions must take its inherently shared nature seriously.”); R. Alta Charo & Henry T. Greely, \textit{CRISPR Critters and CRISPR Cracks}, 15 AM. J. BIOETHICS 11, 14–15 (2015) (discussing possible regulatory responses to “unexpected uses” of CRISPR/Cas9 technology and highlighting regulatory “cracks”); Jorge L. Contreras, \textit{Genetic Property}, 105 GEO. L.J. 1, 1–11, 44–48 (2016) (arguing against what he calls a “de facto property regime” in personal genetic data and proposing changes to research conduct norms to protect research subjects’ interests in their genetic objects in lieu of that “de facto property regime”); Sonia M. Suter, \textit{Disentangling Privacy from Property: Toward a Deeper Understanding of Genetic Privacy}, 72 GEO. WASH. L. REV. 737, 798–811 (2004) (arguing against creating property rights in genetic information and in favor of stronger genetic privacy rights that address dignitary harms); Prince, supra note 41 (reviewing the shortcomings of the laws governing the protection of genetic information and proposing a list of genetic information protections that states ought to enact); Amy L. McGuire, Jessica Roberts, Sean Aas & Barbara J. Evans, \textit{Who Owns the Data in a Medical Information Commons?}, 47 J.L. Med. & Ethics 62 (2019) (reporting the results of an experts survey illustrating the legal and ethical challenges of reconciling property ownership concepts with individuals’ interests in personal genetic information); Kara W. Swanson, \textit{Rethinking Body Property}, 44 FLA. ST. U. L. REV. 193 (calling into question the significance of the traditional gift vs. commodity dichotomy in legal regimes for allocation of body parts and offering an alternative conception of body parts as a form of “civic property” which is not a commodity); Wright Clayton et al., supra note 41, at 4 (discussing the difficulty in developing “broadly applicable legal principles for genetic privacy”); \textit{see also} \textit{PERSONS, PARTS AND PROPERTY: HOW SHOULD WE REGULATE HUMAN TISSUE IN THE 21ST CENTURY?} (Imogen Goold et al. eds., 2021) (a collection of different approaches toward the regulation of genetic objects in the U.K. and elsewhere).

\textsuperscript{44} See supra note 43. For further discussion of how current federal and state statutes approach genetics, see infra Part IV.F. For further discussion of how this article fits within the genetic exceptionalism debate, see supra note 5.

\textsuperscript{45} See also Wright Clayton et al., supra note 41, at 4 (“Given the diversity of actors and their interests, the increasing power of genetic technologies, and the wide variety of ways these data are held, it is difficult to develop broadly applicable legal principles for genetic privacy.”).
framework for incorporating the multi-dimensional nature of genetics into the law. In this Part, we develop our concept of “genetic objects” and offer a taxonomy of seven dimensions of such objects. This taxonomy of dimensions provides a way of separating out the very different aspects of a genetic object in an organized way. The seven dimensions reflect our current best understanding of the prominent roles that genetic phenomena play in our personal, social, economic, medical, political, reproductive, and scientific lives.

A. Genetic Objects

Capturing the full range of interests implicated by legal matters involving genetic phenomena is often complicated by the inadequacy of available terminology. Terms like “genetics,” “genes,” “DNA,” “genetic material,” “genetic data,” and “genetic information” are typically employed to address specific aspects of a genetic phenomenon in a specific context. But no general term refers to all of these phenomena as they exist in every potential legal context. To allow for a general discussion of genetic phenomena in the legal discourse, we propose the term “genetic objects.” Under our framework, the term “genetic objects” replaces narrower terminology, such as “genetic material” or “genetic data,” that tends to focus attention on specific dimensions of genetic phenomena or specific interests in the phenomena. Using the term “genetic objects,” therefore, enables discussing genetic phenomena in a general, holistic manner without compromising accuracy or losing essential elements of such phenomena.

We use “genetic objects” to refer to the various forms of genetic phenomena within the legal discourse. Genetic objects are defined broadly as anything containing a sequence of nucleotides relevant in a legal context. As mentioned earlier, genetic objects may take on many different forms, such as a blood sample, a cheek swab, a hair strand, a lost tooth, nasal mucus, an excised lymph node, a chromosome, a mitochondrion, a virus, plasmid, or bacterium (regardless of whether man-made or naturally occurring), a donated egg, and even an embryo. These things are all, potentially, genetic objects in themselves (provided they are relevant in a given legal context). But they also contain various forms of “genetic objects,” each of which may give rise to different interests that may bear consequences in the legal context.

46. To clarify, genetic information is only one aspect, or dimension, of a genetic object. As discussed in more detail in Parts II.B and III below, this isn’t to say that genetic information alone, when separated from its physical specimen, is no longer to be regarded as part of a genetic object. Rather, under our framework genetic information—regardless of its source, level of anonymity, and use—ought to be considered an integral part of a genetic object notwithstanding the object’s origin, identification, and present physical state.

47. The genetic object may be packed (as in a chromosome) or unpacked (as in mRNA); single- or double-stranded; naturally occurring or synthetic; encoding or non-encoding for proteins; embedded in a protein (e.g., the guide RNA sequence within a Cas molecule); and it may be modified structurally (e.g., by methylation) in a manner that affects the function of the genetic object or unmodified. It may also be human, non-human, or of mixed human and non-human origin.

48. See supra notes 12–13 and accompanying text.
legal discourse. The legal context will determine the relevant genetic object that needs to be considered.

B. A Taxonomy of Genetic Dimensions

Genetic objects are defined as nucleotide sequences, but their significance in and relevance for the legal discourse exceeds their mere physical existence as that sequence and their actual, present physical state. Each genetic object has multiple dimensions and can be contemplated and viewed through different lenses, reflecting these dimensions of the object.\(^{49}\) We provide a nomenclature that includes seven different dimensions of genetic objects that are relevant in the legal discourse: (1) physical-chemical, (2) informational, (3) functional, (4) taxonomic, (5) group-identity-conferring, (6) individual-identity-conferring, and (7) reproductive.\(^{50}\) We describe these seven dimensions below, leaving open the possibility for adding other dimensions as genetics science and its intersection with the law evolve.

1. The Physical-Chemical Dimension of Genetic Objects

Genetic objects are, first and foremost, chemical molecules made of sequences of connected nucleotides.\(^{51}\) Genetic sequences come in many shapes and forms that vary in length and shape.\(^{52}\) They may occur naturally or be man-made (e.g.,

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49. Although we prefer “dimensions,” similar terms such as “characteristics,” “facets,” and “aspects,” may be comparably useful in discussing genetic objects. We occasionally use such terms synonymously with “dimensions” for stylistic reasons.

50. We recognize that the categories we offer may overlap and that the list of categories may be organized differently. See, e.g., Rasheed, supra note 7, at 568–73 (offering a “[t]axonomy of [g]enetic [i]nformation” to assist in elucidating property and privacy interests attached to three types of genetic objects and two kinds of genetic information). We also acknowledge that there may be other aspects of genetic objects that we have failed to recognize (perhaps because they are yet to be discovered and elucidated) or have not done so sufficiently. Finally, we submit that the list of categories brought here is only meant to serve as a tool and, thus, would welcome other methods of categorization that may be more helpful in highlighting the various dimensions of genetic objects within the legal discourse.

51. See supra note 11. In most organisms, these nucleotides are adenosine, cytosine, guanine, and thymine (in DNA) or uracil (in RNA). A genetic object can also consist of other nucleotides that are not part of a naturally occurring genetic sequence, for instance, in synthetic organisms. See, e.g., Denis A. Malyshev, Kirandeep Dhami, Thomas Lavergne, Tingjian Chen, Nan Dai, Jeremy M. Foster, Ivan R. Correa & Floyd E. Romesberg, A Semi-Synthetic Organism with an Expanded Genetic Alphabet, 509 NATURE 385 (2014).

52. For example, genetic sequences can be many millions of nucleotides long (e.g., in chromosome arms) or about twenty nucleotides long (in small interfering RNA (siRNA)); single-stranded or double-stranded; and packed (e.g., when wrapped around histone molecules) or unpacked (e.g., in messenger RNA). See Deoxyribonucleic Acid (DNA), NAT. HUM. GENOME RSC. INST., at https://www.genome.gov/genetics-glossary/Deoxyribonucleic-Acid [https://perma.cc/2C3V-FJZU] (Mar. 27, 2024); Ribonucleic Acid (RNA), NAT. HUM. GENOME RSC. INST., at https://www.genome.gov/genetics-glossary/RNA-Ribonucleic-Acid [https://perma.cc/3278-SC92] (Mar. 27, 2024); Messenger RNA (mRNA), NAT. HUM. GENOME RSC. INST., at https://www.genome.gov/genetics-glossary/messenger-rna
complementary DNA (cDNA). And they can be found within an organism or separate from it.

Despite its significance, the physical-chemical aspect of genetic objects is often overlooked or downplayed in legal analysis, except in patent law, where it takes center stage. Addressing this aspect of genetic objects in the legal analysis reminds us that genetic objects are physical entities that usually originate from living organisms. At least at some level, they are, therefore, remnants of their originator organisms and may be viewed as a lasting part of that organism, although detached from it.

2. The Informational Dimension of Genetic Objects

Most genetic objects give rise to various items of information. The information itself may relay, among other things: (1) the sequence of nucleotides in the genetic object, (2) the location of the genetic object within a larger genetic object or other molecules, (3) the similarity or dissimilarity of the genetic object to other genetic objects within the same organism or in other organisms (e.g., "wild-type variant," "mutation," "chromosome 17"), (4) the function and functionality of the genetic object (e.g., primer, exon, gene, specific allele, mutation), and (5) the effect of the genetic object on the organism.

The informational content of genetic objects is front and center in the legal discourse because it is most readily associated with legally cognizable interests and, sometimes, potentially measurable value. As a result, the informational dimension of genetic objects is frequently emphasized in the legal discourse, sometimes overshadowing interests stemming from other dimensions.

3. The Functional Dimension of Genetic Objects

Many genetic objects have a biological function, which serves a particular role or purpose within the organism. In that regard, genetic objects may be analogous to components in a machine. Genes, for example, serve as a template for making proteins as part of the process known as transcription. Specific genetic sequences that precede genes, known as "promoters," serve functions related to the transcription of their genes. Messenger RNA (mRNA) sequences carry the "instructions" for making proteins from genes to ribosomes, where proteins are made.

The function and functionality of genetic objects are often utilized in science, industry, and medicine. For instance, genetic material may be transferred from one organism to another—sometimes between different species—to achieve a desired result in the latter. Examples include gene therapies and genetically modified...
organisms like Golden Rice. In some instances, the functionality of genetic materials may serve to achieve purposes beyond those they perform in living cells.

Our growing understanding of the function of genetic objects has been known to cause shifts in how we perceive genetic phenomena. An illustrative example is the name “junk DNA,” given to ninety-eight percent of the human genome whose function was unclear in the aftermath of the Human Genome Project. As we now know, much of that DNA plays essential functions in gene regulation, the structure of chromosomal DNA, and more. As a result, the term “junk DNA” is now considered archaic.

4. The Taxonomic Dimension of Genetic Objects

Genetics both determine and reflect an organism’s belonging to a biological taxon and clade. The taxonomic dimension of a genetic object thus reflects an organism’s belonging to a certain taxon or clade down to the level of species and

54. Gene therapy involves the introduction of “external,” therapeutic genetic material into a living cell in order to achieve durable expression of the genetic material in the target cell itself or its daughter cells at a level sufficient to ameliorate or cure disease symptoms. See Katherine A. High & Maria G. Roncarolo, Gene Therapy, 381 NEW ENG. J. MED. 455, 455 (2019). As for genetically modified organisms (GMOs), although definitions of this term vary, they usually refer to organisms whose genome is modified using genetic engineering techniques to improve existing traits or to introduce new traits that do not naturally occur in the organisms. See, e.g., Krishan Kumar, Geetika Gambhir, Abhishek Dass, Amit Kumar Tripathi, Alla Singh, Abhishek Kumar Jha, Pranjal Yadava, Mukesh Choudhary & Sujay Rakshit, Genetically Modified Crops: Current Status and Future Prospects, 251 PLANTA 90, 90 (2020); Theresa Phillips, Genetically Modified Organisms (GMOs): Transgenic Crops and Recombinant DNA Technology, 1 NATURE EDU. 213 (2008).


57. In biology, a taxon (plural taxa) is a group or rank in a biological classification into which related organisms are classified (e.g., kingdom, phylum, class, order family, genus, species, subspecies, etc.). In some cases, traditional taxonomies inaccurately reflect a modern understanding of genetic ancestry and commonality. An example is the traditional classification of birds in their own class (Aves), separate from the reptile class (Reptilia), despite the recent understanding that birds and reptiles have a common ancestry.

58. A clade is a group of biological taxa (usually a species) that includes all descendants of one common ancestor. Clades are another method of classifying biological creatures. Clade, MERRIAM-WEBSTER DICTIONARY (New ed. 2019); Philip D. Cantino, Harold N. Bryant, Kevin de Queiroz, Michael J. Donoghue, Torsten Eriksson, David M. Hillis & Michael S. Y. Lee, Species Names in Phylogenetic Nomenclature, 48 SYSTEMATIC BIOLOGY 790 (1999).
subspecies of the organism\textsuperscript{59} from which a genetic object has originated.\textsuperscript{60} For example, a genetic object originating from a modern human would taxonomically classify its originator as belonging to the Animalia kingdom, Chordata phylum, Mammalia class, Primates order, Hominidae family, \textit{Homo} genus, \textit{Homo sapiens} species, and \textit{Homo sapiens sapiens} subspecies. A very similar object may originate from a member of the Hominidae family but “pin” its owner as belonging to the species \textit{Pan troglodyte} (chimpanzee). Or the object may be one that’s shared by all members of the Hominidae family (or even all primates, mammals, etc.), in which case it might not be possible to learn the exact species or subspecies of the organism from which the genetic object originated. The taxonomic dimension, therefore, may play an important role in the legal discourse, determining the body or bodies of law governing the genetic object.

Interesting questions regarding an organism’s taxonomic identity—and therefore regarding the laws that ought to govern the organism—may arise when it receives a genetic donation from another organism belonging to a different biological species. Examples include transgenic and chimeric organisms.\textsuperscript{61} However, a genetic donation from one organism to another typically does not raise questions regarding its taxonomic identity because most of the organism’s genetic material is identifiable with the recipient organism’s species.\textsuperscript{62} A different result may occur when two individuals from two different but genetically related species procreate such that each provides about half of the resulting progeny’s genetic material. In such cases, the resulting offspring is considered to belong to neither species. Instead, the offspring has a third, “crossed” taxonomic identity.\textsuperscript{63}

\textsuperscript{59} Genetic objects may also be synthetic. As such, they may derive from a synthetic organism, in which case, they may yet serve to classify that organism, or they may be fully synthesized outside of and separate from an organism. See, e.g., Christopher M. Holman, Claes Gustafsson & Andrew W. Torrance, \textit{Are Engineered Genetic Sequences Copyrightable?: The U.S. Copyright Office Addresses a Matter of First Impression}, 35 BIOTECH. L. REP. 103, 104 (2016) (describing the submission of a fully synthesized DNA molecule for registration with the Copyright Office); Andrew W. Torrance, \textit{Synthesizing Law for Synthetic Biology}, 11 MINN. J.L., SCI. & TECH. 629, 634–38 (2010).

\textsuperscript{60} The taxonomic dimension overlaps with both informational and functional dimensions of a genetic object. This dimension, however, goes beyond the mere functional and informational aspects of the object and bears on the biological identity of the organism from which the object had originated.

\textsuperscript{61} Transgenic organisms contain portions of DNA extracted from other organisms. Leslie Pray, \textit{Recombinant DNA Technology and Transgenic Animals}, 1 NATURE EDUC. 51 (2008). For example, GloFish are zebrafish that glow various colors due to the insertion into their genome of a gene encoding for a protein that emits fluorescent light. \textit{Id}. Chimeric organisms result from combining the cells (rather than just genes) of two or more genetically different organisms. See Henry T. Greely, \textit{Defining Chimeras . . . and Chimeric Concerns}, 3 AM. J. BIOETHICS 17, 17–18 (2003).


\textsuperscript{63} \textit{E.g.}, mules (genetic offspring of donkeys and horses), ligers (genetic offspring of lions and tigers), and narlugas (genetic offspring of narwhals and beluga whales). Kurt Benirschke, Lydia E. Brownhill & Margaret M. Beath, \textit{Somatic Chromosomes of the Horse},
5. The Group-Identity-Conferring Dimension of Genetic Objects

Genetics also determine and reflect an organism’s membership in groups and subgroups within the biological species (e.g., dog breeds within the species *Canis familiaris*; different variants of the SARS-CoV-2 virus). In humans, a person’s genetics—along with their language, culture, history, and personal relationships, collectively—determine and reflect their shared identity groups, indicating, among other things, the geographic origins of their ancestors (e.g., Eastern European, South Asian, North African), their belonging to an ethnic group (e.g., Han Chinese, Quebecois French, Native American, Sephardic Jew), and their familial relation to others. A person shares certain genetic sequences and is, statistically speaking, more likely to share certain genetic traits with members of such groups.

Similarly, certain shared genetic traits may be instrumental in creating and shaping human groups even where members of these groups might not necessarily share racial, ethnic, and familial backgrounds. For example, individuals having mutated versions of the FGFR3 gene and develop achondroplasia as a result might identify as belonging to the group of individuals who identify as “Little People.” Similarly, deaf individuals—including those whose deafness is genetic—often consider themselves members of the Deaf culture.

While group identities may provide individuals with meaning, camaraderie, and a sense of belonging, the issue of genetics and group identity is often fraught with sensitivity and disagreement. As such, considering and discussing the group-identity-conferring dimension of genetic objects within the legal discourse ought to be done with sensitivity, bearing certain things in mind. First, it is exceedingly

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difficult to draw a line between social and cultural group classifications and classifications grounded in genetic analysis. We, therefore, leave open the question of how group classifications should factor into the analysis of interests stemming from this aspect of genetic objects.

Second, the differentiation and classification of humans into groups is often offensive and harmful. Nothing in our framework requires doing so where this might be the result. Still, when contemplating the significance and meaning of a genetic object, it is necessary to recognize that humans have always divided and subdivided themselves (and “others”) into groups and that genetic science can sometimes say something, even if just of statistical significance, about an individual’s genetic proximity to groups.

And third, a person’s identity is not merely, or even primarily, a function of their genetics, and genetic factors alone are insufficient for determining one’s identity. Genetics is only one aspect of a person’s identity. Indeed, overfocusing on genetics distorts valid notions of identity where prominent social phenomena such as adoption and migration have taken place. Yet, being an integral part of one’s biology, genetics may point to one’s ancestry and, thus, may confer aspects of one’s identity to the extent one chooses to espouse any part of the heritage associated with such ancestry.

6. The Individual-Identity-Conferring Dimension of Genetic Objects

Genetics is determinative and emblematic of an organism’s individual identity. The vast majority of an organism’s genetic sequence is shared with other organisms of the same species and, to a large extent, with organisms belonging to other closely
related species.\textsuperscript{70} Still, except identical twins, all individual organisms carry genetic variants and combinations of variants unique to them that distinguish them from other individuals within their species.\textsuperscript{71}

Thus, in humans, a person’s genetic makeup is inextricably entwined with their individual identity in the most profound, basic, and intimate way.\textsuperscript{72} Individuals associate their genetics with their traits, predispositions, and medical conditions.\textsuperscript{73} A person’s genetics is considered to confer on a person part of their individuality—their “genetic identity card”—and is of great personal import.

As before, this is not to say a person’s genetics is their identity or even an essential determinant of their identity. Still, a person’s genetics sets them apart from all other individuals and, as such, may receive additional, subjective meanings stemming from that individuality. These meanings, in turn, may give rise to interests deserving of legal consideration.

\textsuperscript{70} See, e.g., The Chimpanzee Sequencing and Analysis Consortium, Initial Sequence of the Chimpanzee Genome and Comparison with the Human Genome, 437 Nature 69, 69 (2005) (finding human and chimpanzee genomes to be almost 99% identical); James F. Crow, Unequal by Nature: A Geneticist’s Perspective on Human Differences, 131 DEDALUS 81, 82 (2002) (discussing the 99.9% genetic similarity within the human species and humans’ genetic similarity with mice, dogs, elephants, and other organisms).

\textsuperscript{71} If we consider an organism’s epigenetics as part of their genetics, not even so-called identical twins are genetically identical. Epigenetics is the study of modifications of the transcription patterns of the genome without making changes to the genetic code itself. See Bob Weinhold, Epigenetics: The Science of Change, 114 ENV’T HEALTH PERSP. A160, A163 (2006); Joseph Loscalzo & Diane E. Handy, Epigenetic Modifications: Basic Mechanisms and Role in Cardiovascular Disease (2013 Grover Conference Series), 4 PULMONARY CIRCULATION 169, 169 (2014). An organism’s epigenetics are known to be affected by environmental factors and—unlike a person’s genetic code—may change significantly over time. See, e.g., Riya R. Kanherkar, Naina Bhatia-Dey & Antonei B. Csoka, Epigenetics Across the Human Lifespan, 2 FRONTIERS CELL & DEV. BIOLOGY, Sept. 9, 2014 at 1–2; Carmen J. Marsit, Influence of Environmental Exposure on Human Epigenetic Regulation, 218 J. EXPERIMENTAL BIOLOGY 71, 71 (2015).

\textsuperscript{72} In the words of legal scholar Jorge Contreras, “[g]enes hold a privileged place in our collective imagination and our notions of what it means to be human. They are the messengers of heredity, determining our physical features, our mental quirks, our susceptibility to disease. They link us to our families, our ancestors, broader social, ethnic, and regional groups, and, at the deepest level, to all living creatures on earth. And, as something with which we are born, and that we can never change (at least, not yet), we consider genes to be integral to our persona and our identities as human beings.” Jorge L. Contreras, Association for Molecular Pathology v. Myriad Genetics: A Critical Reassessment, 27 MICH. TECH L. REV. 1, 26 (2020). See also Prince, supra note 41, at 176 (“[G]enetic information is personal and complexly intertwined with self-identity and family.”).

\textsuperscript{73} This is so although the association of certain genetic traits with phenotypes in the fully formed creature is, with the exception of Mendelian traits, far from straightforward. See, e.g., Jordana Cepelewicz, New Turmoil over Predicting the Effects of Genes, QUANTA MAG. (Apr. 23, 2019), https://www.quantamagazine.org/new-turmoil-over-predicting-the-effects-of-genes-20190423/ [https://perma.cc/942Y-HYKZ]; Denis Noble, Genes and Causation, 366 PHIL. TRANSACTIONS ROYAL SOC’Y A 3001, 3001–02, 3013 (2008); Anne M. Glazier, Joseph H. Nadeau & Timothy J. Atman, Finding Genes That Underlie Complex Traits, 298 SCIENCE 2345, 2345 (2002).
7. The Reproductive Dimension of Genetic Objects

One of the most interesting (and perplexing) aspects of many kinds of genetic objects is that they replicate, thereby conferring a creative potential beyond their carrier individual. As such, genetics is important not just in the function of the individual organism but also in reproduction (i.e., the creation of offspring). In every organism, from viruses to whales, single-celled algae to giant sequoia, reproduction is inextricably tied to genetics.

In human reproduction, a person’s genome is identical to about half of their immediate ancestors’ and descendants’ genomes. At the very basic physical level, a person’s genetic material—about half of which is present in that person’s reproductive cells—serves as the early building blocks of and physical template for that person’s children. The significance of this aspect of genetic objects for the legal discourse cannot be overstated. It gives rise to numerous interests, some recognized by the law and some not—or at least, not yet. And it means that genetic objects, owing to their creative potential, must be considered beyond the context of the person from whom they originate.

8. Additional Dimensions of Genetic Objects

As our knowledge and understanding of genetics—and human genetics in particular—grows, we may discover new meanings, interests, and even additional dimensions of genetic objects. An illustrative example we discussed earlier is our current understanding of those regions of the genome that we used to call “junk DNA.” Another example is our growing understanding of environmental effects on gene expression and this understanding’s potential to shift our perceptions of

74. Since the human Y chromosome is much smaller than the X chromosome and since mitochondrial DNA passes mainly from the egg, a larger share of a human organism’s genetic material originates from the egg than from the sperm cell that fertilized the egg. However, new assisted reproductive technologies could potentially change this biological reality. See, e.g., Sonia M. Suter, In Vitro Gametogenesis: Just Another Way to Have a Baby?, 3 J.L. & BIOSCIENCES, 87, 89–91 (2015) (discussing the potential future application of in vitro gametogenesis (IVG)).

75. See, e.g., Katrina Clark, Who’s Your Daddy?, WASH. POST (Dec. 17, 2006), https://www.washingtonpost.com/archive/opinions/2006/12/17/whos-your-daddy/856d8f09-d17c-4a0c-be1b-5435190b084c/ [https://perma.cc/AF7G-RHVK] (illustrating the significance of genetic ties between parent and offspring when the offspring was conceived with donated reproductive tissue and arguing for recognizing donor-conceived-persons’ interests); Nofar Yakovi Gan-Or, Securing Posterity: The Right to Postmortem Grandparenthood and the Problem for Law, 37 COLUM. J. GENDER & L. 109 (2019) (exploring the legal aspects of bereaved parents’ pursuit of using their deceased children’s gametes to achieve what she calls “postmortem grandparenthood”). See generally Henry T. Greely, THE END OF SEX AND THE FUTURE OF HUMAN REPRODUCTION (2016) (predicting and discussing the implications of sexual intercourse ceasing to be the primary means of human reproduction owing to widespread access to reproductive technology, which would allow for conscious selection of genetic variations).

76. See supra note 56 and accompanying text.
individual agency.\textsuperscript{77} And another example involves the potential legal implications of our relatively recent understanding of how epigenetics affects the expression of genetic traits across generations.\textsuperscript{78}

Inevitably, future discoveries will affect, sometimes dramatically, our view and understanding of the dimensions and meanings of genetic objects within and without legal discourse. This realization lies at the heart of the framework we propose later in this Article.

\textbf{Table 1: Dimensions of Genetic Objects}

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Brief Explanation</th>
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<tbody>
<tr>
<td>Physical-Chemical</td>
<td>The chemical molecule that is made of interconnected nucleotides, single- or double-stranded; inside or outside of a cell nucleus; DNA or RNA; tightly-, loosely- or unpacked; naturally occurring or man-made</td>
</tr>
<tr>
<td>Informational</td>
<td>The different items of information stemming from and embodied in the sequence of nucleotides, for example, their location within a larger genetic object, their similarity or dissimilarity to sequences in other creatures/individuals, their expression in the organism’s body, etc.</td>
</tr>
<tr>
<td>Functional</td>
<td>The biological roles played by genetic objects, including as templates for other genetic objects and proteins, in cell replication, reproduction, regulation of gene expression, and more</td>
</tr>
<tr>
<td>Taxonomic</td>
<td>As indicator of biological classification, including domain, kingdom, phylum, class, order, family, genus, species, and subspecies</td>
</tr>
</tbody>
</table>

\textsuperscript{77} See, e.g., Emily R.D. Murphy, \textit{Brain Without Money: Poverty as Disabling}, 54 CONN. L. REV. 699 (2022) (making a powerful case for viewing poverty as primarily resulting from environmental effects on brain development, which renders poverty more akin to disability and, thus, less the “fault” of individuals in poverty). For an enlightening explanation of the environment’s role in genetic expression, see ROBERT M. SAPOLSKY, \textit{BEHAVE: THE BIOLOGY OF HUMANS AT OUR BEST AND WORST} 227–231 (2017).

\textsuperscript{78} While the term “epigenetics” was first introduced in 1942, the field of epigenetics, as we currently understand it, emerged in the 1990s and received its current form in the early 2000s. See C.H. Waddington, \textit{The Epigenotype}, 41 INT. J. EPIDEMIOL. 10 (2012) (a reprint of Waddington’s original article from 1942); Shelley L. Berger, Tony Kouzarides, Ramin Shiekhattar & Ali Shilatifard, \textit{An Operational Definition of Epigenetics}, 23 GENES & DEV. 781, 781 (2009); Virginia Hughes, \textit{Epigenetics: The Sins of the Father}, 507 NATURE 22, 23 (2014) (discussing mechanisms by which environmental factors affect the expression of genes across generations); Mark A. Rothstein, Yu Cai & Gary E. Marchant, \textit{The Ghost in Our Genes: Legal and Ethical Implications of Epigenetics}, 19 HEALTH MATRIX 1, 10–20 (2009) (discussing potential legal implications of our increasing understanding of epigenetic impact, including in the context of environmental, food and drug, and occupational safety regulation and challenges courts would face when second and third generations bring claims concerning epigenetic harms due to acts that took place during their parents’ or grandparents’ lifetimes).
Group-Identity-Conferring
As indicator of belonging to a specific population or
group within a species, including—in humans—social,
ethnic, and familial groups

Individual-Identity-Conferring
As indicator of belonging to a specific organism within a
group and reflective of and conferring its uniqueness and
individual identity

Reproductive
As related to the integral role played by many genetic
objects in the creation of offspring

* * *

Once the multiplicity of dimensions attaching to a genetic object is exposed, it
becomes easier to identify the broader range of stakeholders and interests that legal
treatment of the genetic object might impact. In the next Part, we show how the
different dimensions of genetic objects lend themselves to interests in such objects
and how such interests can inform legal decision-making.

III. A LEGAL FRAMEWORK: FROM GENETIC DIMENSIONS TO LEGAL INTERESTS

In this Part, we develop the complete framework for capturing the complexity of
genetic phenomena within legal decision-making. After identifying the relevant
object and considering which of the seven dimensions of genetic objects might be
implicated, the framework uses these dimensions to identify and explore the various
stakeholder interests that should be weighed in decision-making involving these
objects. This framework provides a comprehensive way of accounting for and
weighing interests in decision-making involving genetic objects.

A. Interests in Genetic Objects

Simply recognizing that genetic objects have multiple dimensions does not, on its
own, help us identify their legal significance. The reason these dimensions are legally
significant is tied to how they impact things that people care about or what are
generally, although loosely, understood as “interests.” The law is designed to
accommodate and balance competing interests in a legal outcome.79 Interests thus
serve as the mediator between the multiple dimensions of genetic objects and legal
decision-making that implicates genetic objects.

Interests in a genetic object may be associated with an individual or group, the
past, present, or future, and may be monetary or nonmonetary.80 They may attach to

(broadly summarizing the history and benefits of properly weighing the interests of all parties
involved in suits; analyzing the various models of interest balancing).
80. See, e.g., Ram, supra note 7, at 876–77, 891–906 (discussing the individual and group
interests genetic relatives have in each other’s identifiable genetic information resulting from
the shared nature of such information); Roberts, supra note 43, at 1156–63 (providing an
illuminating account of the “[p]lural[ity of] values abound[ing] in the context of genetic
ownership”).
any of the different dimensions of genetic objects or more than one. To have an interest in a genetic object, the individual, entity, or group claiming the interest must have some connection to the object and a stake in its disposition or the outcome of a dispute involving the object. The relation to the genetic object may be relatively remote, giving rise to possible “interest groups” that could potentially encompass the general public, or even future generations, depending on the issues at stake.

The scope of interests in genetic objects that the law recognizes evolves in conjunction with our understanding of genetics and its implications for our inner workings and who we are. Like virtually all other interests recognized by the law, once acknowledged, interests in genetic objects will receive varying levels of respect, weight, and enforceability, depending on social mores, the context in which they arise, and other factors. Some interests may be prioritized, while others may be accorded diminished importance or even frowned upon.

Some interests in genetic objects are unlikely to find appropriate avenues to legal recognition. Dignitary interests, for example, are rarely recognized as legally protected in American law. Although a few legal areas, primarily privacy law and specific genetic rights legislation, have acknowledged such interests as mattering in legal determinations, they tend to receive little protection as such.81 Other interests—for example, control of and access to one’s own genetic information—may sometimes command such high levels of legal recognition that they are embedded in statutes designed to create legal rights in the subject of these interests.82

While it is, perhaps, intuitively easiest to associate interests in genetic objects with specific individuals, as discussed earlier, such interests may also be the subject of human groups.83 Membership in genetic groups may be “horizontal” (i.e., stemming from genetics shared with contemporaries), “vertical” (i.e., stemming...
from genetics shared with previous and future generations), or both.\textsuperscript{84} Shared interests in genetic objects, therefore, have the potential to create, reinforce, or negate membership in human groups. Likewise, membership in human groups may give rise to interests in genetic objects shared by group members. Such interests have been claimed by the descendants of Henrietta Lacks,\textsuperscript{85} members of the Havasupai Tribe,\textsuperscript{86} and families of individuals whose genetic data have been stored in criminal databases,\textsuperscript{87} but they are yet to be legally recognized.

B. Integrating Genetic Interests into the Legal Discourse

As genetic technologies become ubiquitous and their uses continue to expand, it is essential to find a way to incorporate the full range of interests implicated by the plurality of dimensions of genetic objects into the law. Yet, courts, policymakers, and lawmakers rely heavily on existing legal frames in approaching new cases and controversies. At its most basic level, juridical decision-making often involves a sorting exercise in which jurists try to determine a legal conceptual “box” into which to fit (and, sometimes, squeeze) new legal questions. As explained earlier, this practice may work well in most contexts much of the time. However, when genetic phenomena are involved, this practice risks overlooking or downplaying significant interests that stem from fundamental human concerns and values.

There are several ways in which legal decision-making imperils interests involving genetic objects. Sometimes, such interests might not be recognized under the legal “box” jurists tend to prefer when treating a particular kind of legal issue. Sometimes the appropriate legal “box” might not even exist. And sometimes the communal nature of some interests stemming from genetic objects might be so

\textsuperscript{84} With the advent of the science of epigenetics, it is possible to learn about a person’s genetic history and that of their ancestry through genetic transcription patterns. See, e.g., AK Short, KA Fennell, VM Perreau, A Fox, MK O’Bryan, JH Kim, TW Bredy, TY Pang & AJ Hannan, Elevated Paternal Glucocorticoid Exposure Alters the Small Noncoding RNA Profile in Sperm and Modifies Anxiety and Depressive Phenotypes in the Offspring, 6 TRANSLATIONAL PSYCH., June 2016, at 1 (showing that elevated levels of glucocorticoids in male mice is involved in the transmission of stress-induced traits across generations in a process involving small noncoding RNA signals). Such information has the potential to reveal specific events that shaped these patterns, including, possibly, ones that took place even before a person’s lifetime.


\textsuperscript{87} See, e.g., Ram, supra note 7, at 919–29; Murphy, supra note 38.
foreign to jurists’ traditional perceptions of legal rights that they might downplay or outright ignore these interests. Our framework would mitigate these problems by requiring jurists to unpack the multiple dimensions of the genetic object and explore the interests implicated by these dimensions before committing the matter to any specific legal frame. In so doing, the framework creates opportunities for a case-by-case legal response to situations in which existing legal approaches would otherwise tend to exclude or downplay relevant interests. The framework thereby allows for a flexible but comprehensive legal response to areas of disconnect between genetics and the law.

In sum, to allow for consideration of the full range of dimensions of genetic objects in the legal discourse, we propose that jurists use the following framework when confronting legal issues that implicate genetic objects. The framework takes the form of a step-by-step process that would come into play any time a legal decision involves the disposition of a genetic object:

Step 1: Identify the relevant genetic object(s) for the relevant legal situation or question;
Step 2: For each genetic object, “pull out” the various dimensions relevant to that object in the legal situation or question using the taxonomy of genetic dimensions as a starting point;
Step 3: For each dimension, identify interests that might attach to the implicated dimensions of the genetic object(s); and
Step 4: Balance the interests identified in the previous Step to determine whether and how the law should respond to these interests. Potential responses may include, for example, modifying the application of the rule, allowing for one or more defenses to limit the application of the rule, and adopting a particular remedy that reflects interests not contemplated by the rule.

The primary goal of using this framework is to create informed opportunities for the law to weigh and balance relevant interests implicated, but not already encompassed, in legal decision-making governing a genetic object. When applying this framework, legal issues involving a genetic object would begin with an assessment of the dimensions of the object and the interests that might attach to these dimensions. This would entail gathering and responding to information that would have otherwise not been considered, despite its relevance. Separating out the different dimensions of genetic phenomena makes it easier for the decision-maker to identify and respond to the competing interests that a legal decision governing a genetic object may implicate. In judicial decision-making, equitable tools can also be used to respond to the new information and incorporate the interests that might previously have been ignored or downplayed.

88. Tools of equity allow courts to operate within a malleable legal framework that promotes fairness and enables courts to consider dimensions of a legal problem that would otherwise fail to attain recognition. See generally Henry E. Smith, Equity as Meta-Law, 130 Yale L.J. 1050 (2021); Popov v. Hayashi, No. 400545, 2002 WL 31833731 (Cal. Super. Ct. Dec. 18, 2002) (illustrating using equity to introduce into the legal matter competing interests that did not fit within traditional legal constructs and the use of equitable principles to reach a just resolution of the dispute).
The problems arising from jurists’ strong inclination to fit multi-dimensional genetic objects into existing legal boxes make our proposed framework both essential and challenging to implement. The framework is necessary in order to capture the full range of interests implicated in a decision involving genetic objects. And it is challenging because of the need to “think outside the (legal) box.” In some cases, there will be no appropriate “box.” In others, existing legal “boxes” might suffer from inadequacy or a flaw. And challenges will surely arise in balancing the various, sometimes numerous, interests involved, which might require tradeoffs and changes to existing legal doctrine to afford recognition and protection of previously unrecognized interests in genetic objects.

Ultimately, despite the challenges, our framework could help remedy current deficiencies in how the law addresses genetic phenomena in several ways. First, it could help jurists avoid problems caused by the limitations of existing legal doctrines when applying them to a legal matter involving a genetic object. Second, it could facilitate full consideration of interests yet to receive legal recognition or that have thus far evaded direct balancing with other interests. Third, it may lower the likelihood of fragmentation when the legal resolution of issues implicated by one dimension of a genetic object is at odds with interests implicated by other dimensions of that same object. And fourth, it could prevent injustice.

In the next Part, we discuss several high-profile cases and legislative efforts in different areas of law to illustrate deficiencies in legal decision-making and policy-making in matters involving genetic objects and to demonstrate how our framework could remedy such deficiencies.

IV. APPLYING THE FRAMEWORK

As genetic technology advances and becomes increasingly ubiquitous, legal issues involving genetic objects become increasingly common. This Part discusses how courts and policymakers have struggled to respond to legal questions raised by genetics. We show that this struggle is driven by a lack of appropriate terminology and analytical tools, resulting in failure to accommodate, and sometimes even acknowledge, the multi-dimensionality of genetic phenomena and the plurality of interests implicated. To date, the law’s approach to new legal questions raised by genetic phenomena has relied chiefly on adapting existing legal constructs to challenges created by genetic technology, using the analytical tools of traditional legal regimes. The outcome has been a focus on limited aspects of genetic objects and a narrow range of stakeholder interests which ignores or gives cursory nods to other aspects of the genetic objects concerned and the interests they implicate. Sections A–E below use our terminology to illustrate these phenomena in a series of cases and one legislative effort involving genetic objects and show how our framework could have led to a different, potentially better outcome. Section F draws some conclusions on how our terminology and framework could assist jurists.

A. Failures to Recognize Interests in Genetic Objects Involved in Research

At least since the 1970s, with the evolution of biotechnology and biomedicine, the law has struggled to reconcile its traditional property constructs with claims of
enduring interest in genetic objects obtained and used in research contexts. The increasing commodification of genetic objects by research scientists and biotechnology firms has fueled tensions between competing concepts of personal, commercial, and scientific interests in the legal treatment of genetic samples. These tensions, however, have not been adequately acknowledged and addressed in legal decisions concerning the disposition of such samples.

High-profile cases, such as the recent lawsuit brought by the estate of Henrietta Lacks against a biotechnology company accused of using Lacks’s cells without her initial knowledge or consent, highlight the lingering issues and ongoing damage when interests in genetic objects remain unaddressed. Few courts are willing to confront these tensions directly in their decisions. It is, therefore, no surprise that more than three decades after being decided, the cases of *Moore v. Regents of the University of California* and *Greenberg v. Miami Children’s Hospital Research Institute, Inc.* are still being debated. These cases remain among the most prominent examples of the ongoing struggle between property constructs and

89. See, e.g., Diamond v. Chakrabarty, 447 U.S. 303 (1980) (addressing the patentability of man-made genetically modified bacteria); Wash. Univ. v. Catalona, 490 F.3d 667, 675–77 (8th Cir. 2007) (affirming the treatment of genetic samples as gifts under state law and ruling that tissue samples donated for research on the genetic basis of prostate cancer were the property of the recipient institution and that the individuals who donated the tissue could not “redirect” or “transfer” the donated samples since they have not retained the right to do so when making the donation); Beleno v. Lakey, 306 F. Supp. 3d 930 (W.D. Tex. 2009) (a lawsuit filed by parents seeking the destruction of genetic samples collected from their newborn children and stored, without their knowledge and consent, by state health authorities as part of the state’s program for screening newborns for genetic diseases).

90. See Complaint, supra note 85. See also generally REBECCA SKLOOT, THE IMMORTAL LIFE OF HENRIETTA LACKS (2010); Alexandra Witze, Wealthy Funder Pays Reparations for Use of Stolen Cells, 587 Nature News 20 (2020) (reporting a “six-figure gift” to the Henrietta Lacks Foundation from the Howard Hughes Medical Institute (HHMI), a biomedical research organization, for its continuing experimental use of HeLa cells and quoting HHMI’s President saying, “We felt it was right to acknowledge Henrietta for the use of HeLa cells and to acknowledge that the cells were gained inappropriately.”). We note that similar problems may underlie the law’s approach to cases involving the rights of “genetic heroes.” See Stephen H. Friend & Eric E. Schadt, Clues from the Resilient, 344 Sci. 970 (2014). We leave the analysis of these problems and such matters for future treatment.


93. See, e.g., Jessica L. Roberts, Negotiating Commercial Interests in Biospecimens, 45 J. L., Med., & Ethics 138, 138–39 (2017) (discussing how the lessons of *Moore* and *Greenberg* might prompt research subjects to negotiate a share of any commercial interests resulting from research involving their biospecimens); Roberts, supra note 43, at 1124–25 (contrasting the genetic ownership that biotech companies have in their databases with the lack of individual ownership rights expressed in *Moore* and *Greenberg*). But see Contreras, supra note 43, at 3–11 (taking the opposite position regarding property rights in personal genetics). See also Mark Verstraete, Inseparable Uses, 99 N.C. L. Rev. 427, 460–62 (2021) (arguing that certain body parts and reproductive materials ought to be regarded as normatively inseparable from the person from whom they originated); Rasheed, supra note 7 at 563–66.
competing claims in genetics because they are among the few to date that tackle the issue of property in genetics head-on.

In both Moore and Greenberg, courts were asked to recognize enduring interests that individuals—not just patients—and their families have in genetic objects. And in both cases, after struggling to reconcile the plaintiffs’ claims and the interests these claims implicated with existing law, courts failed to recognize the plaintiffs’ critical interests in the genetic objects at issue.

1. Moore v. Regents of the University of California

In Moore, a cancer patient sued the doctors who had removed his spleen, blood, and other bodily substances and then capitalized on the unique genetic makeup of the excised material, which they turned into a patented and potentially profitable cell line. The patient, John Moore, was initially unaware that his tumor was the subject of intense scientific and commercial interest. After finding out that the defendants had used his genetic objects without his knowledge and consent, Moore sought various remedies under various causes of action, including conversion, unjust enrichment, interference with prospective advantageous economic relationships, and slander of title. Moore’s argument was, essentially, that he had property rights in his genetics.

The trial court rejected Moore’s claims, holding that “there was no recognized cause of action for the claim . . . and the court did not intend to create a new cause of action.” However, the California Court of Appeals was more receptive to the idea that Moore might have enduring interests in his genetics. It held that a person’s “cells and genes are a part of his person” in which a person has a property interest and that Moore “enjoyed the unrestricted right to use, control, and dispos[e]” of his bodily substances. The court of appeals took a property-grounded approach and was willing to extend ownership rights to materials that have been removed, even discarded, from one’s body.

The California Supreme Court disagreed with the court of appeals and rejected Moore’s property claims. In a deeply divided opinion, the California Supreme Court, while not rejecting a property rights approach per se, held that Moore did not have an ownership interest in his excised cells. It stated that “[n]o court . . . has ever . . . imposed conversion liability for the use of human cells in medical research” and

94. Moore, 249 Cal. Rptr. at 498.
95. Id. at 498–99.
96. Id. at 501 (“his Blood and Bodily Substances, including . . . his . . . genetic material, [and] genetic sequences . . . [we]re his tangible personal property, and the activities of the defendants . . . constitute[d] a substantial interference with [his] possession or right thereto . . . .”).
97. Id. at 502.
98. Id. at 505, 508 (internal citations omitted). But see id. at 537 (George, J., dissenting).
99. Moore v. Regents of Univ. of Cal., 793 P.2d 479 (1990). With its three rounds of litigation and two dissenting opinions in the California Supreme Court case, the case of Moore offers at least four different approaches to Moore’s claims. Our analysis here will focus on the California Supreme Court’s majority opinion.
expressed the view that the viability of such a claim is belied by a California statute that required the destruction of human remains after scientific use.\textsuperscript{100} The California Supreme Court also expressed grave concerns that accepting Moore’s conversion claim “would affect medical research of importance to all of society” since it would allow Moore to “claim[] ownership of the results of socially important medical research, including the genetic code for chemicals that regulate the functions of every human being’s immune system.”\textsuperscript{101} And it held that “the subject matter of the [defendants’] patent—the patented cell line and the products derived from it—cannot be Moore’s property . . . because [they are] both factually and legally distinct from the cells taken from Moore’s body.”\textsuperscript{102} The court’s decision in this regard rested heavily on policy arguments focusing on the informational and functional aspects of genetics\textsuperscript{103} and on framing property rights—especially those stemming from IP frameworks—as instrumentally necessary to allow for unhindered medical research and, more broadly, innovation. The majority warned that “the theory of liability that Moore urges us to endorse threatens to destroy the economic incentive to conduct important medical research. If the use of cells in research is a conversion, then with every cell sample a researcher purchases a ticket in a litigation lottery.”\textsuperscript{104} Thus, the California Supreme Court was able to reject Moore’s conversion claim by placing a premium on the instrumentality of property rights, adopting a particular doctrinal framework designed to avoid what it feared would be chilling effects on scientific research.

The California Supreme Court majority also rejected the notion that a person’s genetic materials are emblematic of their identity\textsuperscript{105} and the court of appeals’ view that depriving a person of the “ultimate power to control what becomes of his []

\textsuperscript{100} Id. at 487, 491–92. Notably, in dictum, the California Supreme Court did recognize that “some limited right to control the use of excised cells does survive the operation of this statute.” Id. at 492.

\textsuperscript{101} Id. at 487–88.

\textsuperscript{102} Id. at 490–91.

\textsuperscript{103} See supra Parts II.B.2 and II.B.3, respectively.

\textsuperscript{104} Moore, 793 P.2d at 495–96. The majority noted, for example, that “liability for conversion is predicated on a continuing ownership interest” and that extending ownership constructs to cover excised cells would potentially lead to “uncertainty about clear title,” which in turn would likely cause companies to underinvest in research and development. Id. at 494–96.

\textsuperscript{105} Id. at 489–91 (rejecting the court of appeals’ use of right of publicity law to support Moore’s conversion claim).
tissues . . . would open the door to a massive invasion of human privacy and dignity."\(^{106}\) It cast down Moore’s analogies of his interests in the genetic objects to those protected under privacy and IP laws as unconvincing\(^{107}\) and characterized the court of appeals’ receptiveness to these arguments as “forc[ing] the round pegs of ‘privacy’ and ‘dignity’ into the square hole of ‘property.’”\(^{108}\)

Viewing Moore through the lens of our framework reveals that in the court’s urgency to thwart what it perceived as Moore’s moneymaking attempt and to protect scientific research, it committed several fundamental mistakes. First, the court repeatedly failed to correctly characterize and address the genetic objects of Moore’s conversion claim, conflating it with other, not necessarily genetic, objects. The (correct) genetic object in Moore was the nucleotide sequence of the mutation in Moore’s spleen cells that caused these cells to become cancerous but also made them extremely useful as bio-factories for certain valuable biological compounds known as lymphokines.\(^{109}\) The California Supreme Court mischaracterized Moore’s claim as aimed at the “ownership of . . . the genetic code for chemicals that regulate the functions of every human being’s immune system.”\(^{110}\) But Moore’s conversion claim, while not saying so explicitly, was not focused on Moore’s cells’ ability to produce lymphokines. Instead, the focus of Moore’s conversion claim was the unique mutation that made Moore’s cancerous spleen cells produce lymphokines in great quantity. That genetic mutation had made Moore’s cells unique (and, thus, uniquely beneficial) and, contrary to the court’s assertion, was not shared by all humans (or it would not have been valuable).

More importantly, the California Supreme Court downplayed and ignored Moore’s vital interests in the genetic objects that were the subject of his lawsuit. In his conversion claim, Moore sought to address interests stemming from the genetic objects’ physical-chemical and individual-identity-conferring dimensions.\(^{111}\) Moore presented the wrongs inflicted upon him as the physical taking away of his genetic objects, the use of those objects without his permission, and the disregard of his identity with the genetic objects as part of his unique self.\(^{112}\) Therefore, Moore asked that the court acknowledge his interests in the genetic objects by recognizing that he had property rights in the products of the defendants’ research, which were derived from and contained the genetic objects taken from him.\(^{113}\)

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106. *Id.* at 491.
107. *Id.* at 488–92.
108. *Id.* at 491.
109. *Id.* at 480–83.
110. *Id.* at 488, 490 (“Lymphokines . . . have the same molecular structure in every human being . . . [that] is no more unique to Moore than the number of vertebrae in the spine or the chemical formula of hemoglobin.”).
111. See supra Parts II.B.1 and II.B.6, respectively.
112. Moore, 793 P.2d at 487 (“[Moore] theorizes that he continued to own his cells following their removal from his body, at least for the purpose of directing their use, and that he never consented to their use in potentially lucrative medical research.”); *id.* at 490 (“one’s own genetic material . . . [is] profoundly the essence of one’s human uniqueness”).
113. *Id.* at 487 (“Moore claims a proprietary interest in each of the products that any of the defendants might ever create from his cells . . . ”). Note that the court’s use of the term “interest” in “property interest” is synonymous with “right” and different from our use of the
The California Supreme Court, however, disregarded the interests stemming from the physical-chemical and individual-identity-conferring dimensions of the genetic objects and, instead, focused exclusively on the objects’ informational and functional dimensions. This oversight (or maneuver) is evident, for example, in the court’s characterization of the object of Moore’s claim as “[the] manufacture [of] lymphokines” (rather than the relevant genetic sequence). In another example, the court mischaracterized Moore’s conversion claim as directed at the informational and functional aspects of the defendants’ research and IP. But Moore’s property claim was not that he owned the manufacturing of lymphokines or the defendants’ IP. It focused on the physical objects—cells and blood samples—that were unique to him and that were taken from his body and used without his knowledge and consent.

Overlooking or downplaying the significance of the physical-chemical and individual-identity-conferring dimensions of the genetic objects of Moore’s claims enabled the California Supreme Court to reach what the Court perceived as the desirable outcome of keeping Moore’s hands off of the defendants’ profits from their IP. But, as recognized by Justice Mosk’s compelling dissent, it ignored Moore’s legitimate interests and resulted in injustice.

Applying our framework to Moore would have likely led to a very different result. Correctly identifying the genetic object and acknowledging and weighing its physical-chemical and individual-identity-conferring dimensions would have required the California Supreme Court, at the very least, to acknowledge Moore’s interests stemming from these dimensions of the genetic object and weigh them against the other interests identified by the court. Once acknowledged, although the court could have afforded Moore’s interests low weight, it likely would not have been able to dismiss these interests altogether. It would have had to explain why the defendants’, and possibly society’s interest in the informational and functional dimensions of Moore’s genetic object take precedence over Moore’s interests. Such weighing, we posit, would have likely given the California Supreme Court significant pause and led it to balance the competing interests differently, more in line with the opinion issued by the court of appeals and Justice Mosk’s dissent. Ultimately, using our proposed framework would have likely made the California Supreme Court more receptive to acknowledging Moore’s legitimate interests in the genetic objects.

term “interest” to describe Moore’s relation to the genetic objects.

114. See supra Parts II.B.2 and II.B.3, respectively.

115. Moore, 793 P.2d at 490 (emphasis added).

116. Id. at 489–93 (”[T]he subject matter of the [defendants’] patent—the patented cell line and the products derived from it—cannot be Moore’s property . . . because [they are] both factually and legally distinct from the cells taken from Moore’s body.”).

2. Greenberg v. Miami Children’s Hospital

In Greenberg, plaintiffs were parents of children afflicted with Canavan disease (Canavan Families), who shared their children’s biological samples—including blood, urine, and autopsy samples—with a physician seeking to isolate the gene responsible for this invariably lethal disease. Unbeknownst to the Canavan Families, the physician and his research group, having successfully identified the Canavan Gene, applied for and received patents on the gene, its mutated versions, methods of diagnosing the mutations, and more. Once the Canavan Families learned that the researchers were attempting to enforce their patents against entities offering Canavan testing, they sued the researchers seeking to enjoin their efforts to enforce their patents and asking for damages.

The Canavan Families’ suit contained several causes of action, including lack of informed consent, unjust enrichment, conversion, and misappropriation of trade secrets. On summary judgment, the United States District Court for the Southern District of Florida dismissed virtually all of the Canavan Families’ property claims for failure to state a claim upon which relief may be granted. The court characterized the Canavan Families as “donors,” found them to have had no “special relationship” with the physician leading the research, and opined they suffered no legally cognizable injury. Specifically, concerning the Canavan Families’ conversion claim, the district court held that the families had “no cognizable property interest in body tissue and genetic matter donated for research.”

However, an analysis of the court’s decision using our framework reveals several mistakes similar to those made in Moore. First, like in Moore, the Greenberg court failed to acknowledge the Canavan Families’ interests stemming from the physical-chemical and individual-identity-conferring dimensions of the genetic object(s). The objects were, literally, flesh and blood of the Canavan Families’ dead and dying children and, thus, invoked a strong sense of identity and ownership in the plaintiffs.

118. Canavan Disease is a neurological developmental disorder that leads to deficient development of the brain and progressive brain atrophy. Canavan Disease typically appears in the first few months of life and progresses rapidly, with death usually occurring before the age of ten. The disease has no cure and treatment is limited to the symptoms and to supporting affected children. See Canavan Disease, NAT’L INST. OF NEUROLOGICAL DISORDERS & STROKE (Jan. 23, 2023), https://www.ninds.nih.gov/Disorders/All-Disorders/Canavan-Disease-Information-Page [https://perma.cc/22TJ-6SSM].

121. Greenberg, 264 F. Supp. 2d at 1068. Notably, the Canavan Families’ lawsuit did not include a breach of contract claim, presumably since there was no formal agreement between the parties. See id.
122. Id.
123. Id. at 1071–77.
124. Id. at 1074.
125. See supra Parts II.B.1 and II.B.6, respectively.
Even more importantly, the Greenberg court failed to recognize the Canavan Families’ interests stemming from the group-identity-conferring dimension of the genetic objects, which were the real cause and motivation for their cooperation with the researchers and, ultimately, their lawsuit. From the outset of the Canavan Families’ collaboration with the defendants, the families’ primary motivation was to share the benefits of the research with the entire Canavan community, with which they had a strong sense of solidarity. These interests drove the Canavan Families’ actions throughout their efforts to support the defendants’ research and stood in stark contrast to the defendants’ interest in restricting access to the benefits of the research. Indeed, the Canavan Families only filed their lawsuit after discovering the defendants were using their IP to foreclose access to Canavan testing.

The Greenberg court, while aware of these sentiments, failed to recognize the interests stemming from them and to incorporate these interests into its legal calculus. The most significant example of this failure was the court’s unwillingness to hold that the Canavan Families’ heartfelt motivations and actions—of which the defendant-researchers were well aware and on which they relied and, quite literally, banked—created a fiduciary relationship between the Canavan Families and the defendants. Such a relationship would have required the defendants to “disclose all essential or material facts pertinent or material to the transaction at hand,” including their financial motivations and intentions to monetize the research results. The Greenberg court, however, accepted the defendants’ argument that, although the Canavan Families placed their trust in the defendant-researchers, the Canavan Families did not sufficiently establish that “the trust was recognized and accepted.” In so doing, the Greenberg court significantly downplayed the crux of the relationship between the parties, which also gave rise to the Canavan Families’ interests and sentiments leading to the lawsuit.

The Canavan Families gave the defendant-researchers everything they could—money, networking assistance, and tissue harvested from their deceased and dying children. In return, they expected their efforts would benefit others who suffered similar misfortune or carried the Canavan mutation. The researchers, apparently, undertook no explicit obligations concerning the Canavan Families. But to say that

magazine/may-2003/owning-a-piece-of-jonathan/ [https://perma.cc/Z8JC-7ETN] (quoting one of the members of the Canavan Families saying, “I gave myself and my son and anything [the doctor] wanted to help wipe out this disease . . . [my son] was as much a part of this discovery—all the children were—as the hospital. Why should they make money on my child, on everything my child donated?”).

127. See supra Part II.B.5.

128. See Greenberg, 264 F. Supp. 2d at 1066–67; see also Suter, supra note 43, at 740–41 nn.7–9 and accompanying text (discussing the Greenberg plaintiffs’ interests and motivations); Hahn, supra note 126.

129. The Canavan Families’ altruistic and community-minded actions were evinced not only by their efforts to provide the researchers with blood and tissue from their children, but also by their provision of financial support for the research and their further aid in identifying additional Canavan families internationally. See Greenberg, 264 F. Supp. 2d at 1067.

130. See id. at 1071–72.

131. Id. at 1071.

132. Id.
the defendant-researchers did not acknowledge and accept the families’ trust is to say that they never asked themselves: “Why are these strangers helping me/us?” “Why are they allowing me/us to take pieces of their dead children and draw blood from their dying children?” “And how come they give me/us money and ask for nothing in return?” Indeed, it is implausible that these thoughts have never crossed the minds of the defendant-researchers. It is similarly implausible that, accepting the plaintiffs’ undeniably deeply personal gifts, the defendants believed they owed the plaintiffs nothing in return. This, however, was precisely what the Greenberg court held. In so doing, the Greenberg court effectively ignored the Canavan Families’ interests stemming from the physical-chemical, individual-identity-conferring, and group-identity-conferring dimensions of the genetic objects.

Like with Moore, applying our framework to Greenberg would have likely led to a different result. First, it would have made the court acknowledge the profoundly personal (and grim) nature of the genetic objects in this lawsuit. Second, it would have driven the court to acknowledge and ponder the Canavan Families’ legitimate interests in these genetic objects. And third—and this is where the Greenberg court’s failure is most evident—it would have forced the court to consider the Canavan Families’ interests and balance them against those of the defendant-researchers. Such consideration would have probably led the Greenberg court to a different outcome on two crucial issues. First, it would have driven the court to deem the relationship between the parties special and recognize the existence of fiduciary duties by the defendants toward the Canavan Families. Second, it would have compelled the court to acknowledge that, like Moore, the Canavan Families indeed had cognizable interests in the genetic objects. Arriving at that conclusion could have probably factored into the court’s consideration of whether these Canavan Families’ interests rise to the level of a property interest for purposes of the conversion claim. But, even if the interests had not risen to that level of legal recognition, it would have given these interests the acknowledgment and consideration they deserved.

* * *

Moore and Greenberg are prime examples of judges’ (and the law’s) failure to sufficiently acknowledge and enforce enduring interests that individuals and their families have in genetic objects that were once part of their bodies or the bodies of their kin. In considering Moore’s and the Canavan Families’ claims, the California Supreme Court and the District Court for the Southern District of Florida approached the matters before them as though the genetic objects in these cases existed mainly or exclusively as informational and functional entities. They ignored these objects’ being, literally, the plaintiffs’ flesh and blood and their significance for the plaintiffs’ identities and sense of self. As a result, the Moore and Greenberg courts failed to consider the plaintiffs’ legitimate and genuine interests in these genetic objects. These interests may not have risen to the level of ownership, but, as Justice Mosk correctly maintained in his dissent in Moore, that did not mean these interests

133. Id. at 1072 (“There is no automatic fiduciary relationship that attaches when a researcher accepts medical donations and the acceptance of trust, the second constitutive element of finding a fiduciary duty, cannot be assumed once a donation is given.”).
amounted to nothing.\textsuperscript{134} The Moore and Greenberg courts’ failure to identify, acknowledge, and recognize these interests reflects the largely mono-dimensional way courts and, more broadly, the law tend to approach genetic objects. As demonstrated above, our framework could assist in broadening judges’ perspectives in matters involving genetic objects and avoiding the potential negative ramifications of judicial tunnel vision.

\textbf{B. The Failures of Association for Molecular Pathology v. Myriad Genetics}

As new advancements in genetics have fueled biomedical innovation, jurists have struggled to reconcile traditional property constructs with claims involving other interests in genetic objects. One legal area in which this struggle has long been apparent is IP. Efforts to patent new products and processes emerging from advancements in genetic science have been creating tensions between competing concepts of personal, commercial, and scientific interests in the legal treatment of genetic objects. These tensions are, however, often left unaddressed in legal decisions, as courts frame disputes over access to genetic innovations primarily in property terms. The case of Association of Molecular Pathology v. Myriad Genetics\textsuperscript{135} serves to illustrate how a narrowing property frame has affected a court decision to the detriment and exclusion of a broad range of interests in genetic objects.

Scientists at Myriad, a genetics and precision medicine company,\textsuperscript{136} played a significant role in identifying the precise location and sequence of two human genes commonly known as BRCA1 and BRCA2.\textsuperscript{137} Even before Myriad’s discovery, it had long been known that people carrying certain hereditary factors were at a higher risk of developing breast and ovarian cancers, but the exact location of the genes and their sequence had remained unknown.\textsuperscript{138} After Myriad’s sequencing of the genes, the company applied for and was granted several patents.\textsuperscript{139} The patents litigated in the Myriad cases covered, among other things, the isolated BRCA1 and BRCA2 genes and complementary DNA (cDNA) sequences of these genes.\textsuperscript{140}

\textsuperscript{134} Moore v. Regents of Univ. of Cal., 763 P.2d 479, 509–11 (Cal. 1988) (Mosk, J., dissenting).
\textsuperscript{135} 569 U.S. 576 (2013).
\textsuperscript{137} The idea that Myriad scientists alone were the first to identify the location of the BRCA1 and BRCA2 genes has been disputed. See, e.g., Lara Cartwright-Smith, Patenting Genes: What Does Association for Molecular Pathology v. Myriad Genetics Mean for Genetic Testing and Research?, 129 LAW & PUB.’S HEALTH 289, 289 (2014) (“Myriad’s competitors dispute this history, arguing that multiple researchers, many of whom are publicly funded, contributed to the discovery of the locations of BRCA1 and BRCA2.”).
\textsuperscript{138} See Mary-Claire King, “The Race” to Clone BRCA1, 343 SCIENCE 1462, 1462 (2014).
\textsuperscript{140} cDNA can be described as “an edited man-made copy of [a] gene.” See Megan Krench, New Supreme Court Decision Rules That cDNA Is Patentable What It Means for Research and Genetic Testing, SCI. AM. (July 9, 2013), https://blogs.scientificamerican.com/guest-blog/new-supreme-court-decision-rules-that-
Ownership and control of these patents allowed Myriad to be the sole party in the United States offering diagnostic testing for the BRCA1 and BRCA2 genes, enabling the company to charge monopolistic prices of over $3,000 per test. Many patients who needed to have their BRCA1 and BRCA2 genes tested could not afford it, and most insurance plans did not cover BRCA1 and BRCA2 testing.

The Association for Molecular Pathology (AMP)—a not-for-profit scientific society—and other plaintiffs sued Myriad, seeking a declaratory judgment that Myriad’s patent claims drawn to cDNA and the isolated BRCA1 and BRCA2 genes were invalid. The Federal District Court for the Southern District of New York decided in favor of the plaintiffs, holding that the patents were invalid because they were directed at “products of nature,” a category of inventions long held to be unpatentable. In its opinion, the district court framed the legal issues at stake as residing at the intersection of “molecular biology and patent law.” It announced at the outset of its opinion that the court’s “task [was] to seek the governing principles in each [of the fields of molecular biology and patent law] and to determine the essential elements of the claimed biological compositions and processes and their relationship to the laws of nature.” Although the district court recognized that multiple stakeholders—well beyond the realm of patent law—would be affected by its decision, it dedicated its lengthy opinion almost exclusively to the issue of Myriad’s patents’ validity.

But in its framing of the case as limited to “molecular biology and patent law,” the district court effectively reduced the scope of the case to the application of patent law (the products of nature doctrine) to discrete biological phenomena (genetic cDNA is a copy of messenger mRNA, but is more stable than mRNA, allowing for its longer preservation in-vitro. The cDNA copy is made through chemical synthesis, with scientists using an enzyme to catalyze a reaction using single-stranded RNA. Id. See Ass’n for Molecular Pathology v. U.S. Pat. Off., 702 F. Supp. 2d at 103.


147. Id.

148. Id. (“The resolution of the issues presented to this Court deeply concerns breast cancer patients, medical professionals, researchers, caregivers, advocacy groups, existing gene patent holders and their investors, and those seeking to advance public health.”).

149. Id.
sequences in isolated and cDNA form). In so doing—despite its unmistakable sympathy to many of the plaintiffs’ arguments—the court effectively sidestepped the need to rule on the other, more complex, and non-patent-related arguments raised by the plaintiffs—arguments that did not fall neatly under any well-defined body of law.

Having inherited what looked to be an exclusively patent dispute, the Court of Appeals for the Federal Circuit focused on the issue of patentability and, in a divided opinion, reversed the district court, holding that both cDNA and the isolated BRCA1 and BRCA2 genes were patent eligible. Likewise, although the Supreme Court disagreed with both lower courts’ patentability analyses, its opinion retained the exclusive focus on the question of patentability. According to the Supreme Court, merely isolating the BRCA1 and BRCA2 genes did not render the genes’ isolates patentable, as their claimed form was not significantly different from the naturally occurring genetic sequences from which they had been derived. Still, in a departure from the holding of the district court and agreement with the Federal Circuit, the Supreme Court ruled that cDNA was patent eligible.

Although the holding in *Myriad* ultimately represented a victory for those opposed to patenting human genes, it failed to look beyond the informational dimension of the genetic objects implicated in the case. The *Myriad* courts’ persistent focus on a single dimension of the genetic objects stood in stark contrast to the more comprehensive approach taken by the American Civil Liberties Union (ACLU), which co-represented AMP in the case. The ACLU framed the case as implicating important interests beyond those related to patentability.


151. See id. at 1177–82 (offering a nuanced analysis of the district court’s opinion as reflecting narratives offered by the plaintiffs in the case).

152. See infra notes 161–167 and accompanying text.


154. Id. at 590–91; cf. Contreras, supra note 150, at 1177–87.

155. Ass’n for Molecular Pathology v. Myriad Genetics, 569 U.S. at 595. This result followed from the Supreme Court’s view that cDNA “retains the naturally occurring parts of DNA” but, unlike the isolated genes, omits other parts (known as introns), thus becoming a “distinct” product from the natural sequences from which it had been derived. Id. This framing allowed the Supreme Court to categorize cDNA as a man-made product rather than a “product of nature” and, as such, hold it patent eligible. Id. at 580, 595.

156. See CONTRERAS, supra note 139, at 313–16.

157. Cf. Contreras, supra note 150, at 1177–82, 1186–87 (highlighting the inclusion in the district and Supreme Courts’ opinions of seemingly irrelevant facts and superfluous discussion unnecessary for resolving the question of patentability).

158. See Sandra S. Park, *Gene Patents and the Public Interest: Litigating Association for Molecular Pathology v. Myriad Genetics and Lessons Moving Forward*, 15 N.C. J.L. & TECH. 519, 520–27 (2014) (an account by one of the ACLU’s attorneys regarding the broader reasons that drove the ACLU to initiate the case).

159. Id. at 527–28; *Myriad*, 569 U.S. at 580, 586.
The first legal document in the case—AMP’s 2009 complaint—framed the interests at stake by connecting the patent-related aspects of the case to the physical-chemical, functional, and identity-conferring dimensions of genetic objects. “Every person’s body contains human genes, passed down to each individual from his or her parents. These genes determine, in part, the structure and function of every human body. This case challenges the legality and constitutionality of granting patents over this most basic element of every person’s individuality.”

AMP’s Complaint also framed the informational dimension of the BRCA1 and BRCA2 genes as not merely an object of scientific research and IP but also as giving rise to interests in having access to that information.

From the perspective of this broader framing of the case and interests at stake, AMP’s complaint argued that upholding the patents on the BRCA1 and BRCA2 genes would prevent many patients, particularly women, from obtaining information about their individual risk of developing certain cancers. The detrimental effects of upholding the patents were, therefore, presented as undermining informational interests (with many women being unable to obtain information about their own genetics) and functional interests (as that lack of information affects women’s ability to obtain timely medical advice and therapeutic interventions). Similarly, AMP’s complaint argued that upholding the validity of Myriad’s patents would harm—and has already harmed—minority populations because it would allow Myriad to continue offering its services to (and, consequently, focus its R&D efforts on) affluent populations.

The district court opinion, however, sidestepped virtually all of these additional interests while providing exhaustive doctrinal treatment to all patent-related issues, both big and small, raised by the litigants.

162. See supra Parts II.B.1, II.B.3, II.B.5, and II.B.6, respectively.
163. Myriad Complaint, supra note 161, at 1.
164. See supra Part II.B.2.
165. Myriad Complaint, supra note 161, at 2 (noting that patent protection for the BRCA1 and BRCA2 genes prevents women “from obtaining information about their health risks”) (emphasis added).
166. This is because the mutations affecting BRCA1 and BRCA2 genes are tied predominantly to a heightened risk of developing breast and ovarian cancers. Id. at 28.
167. As Myriad’s complaint put it, granting Myriad the patents on BRCA1 and BRCA2 had “resulted in a disparity in the amount of information known about genetic mutations in BRCA1 and BRCA2 in ethnic groups other than Caucasians.” Id. at 26.
169. Id. at 214–16.
170. Id. at 216–17.
matter and its application to Myriad’s patents. Although the district court gave a cursory nod to the plaintiffs’ concerns regarding the harmful effects of the patents on women, it framed the dispute as one primarily anchored in patent eligibility concerns. In so doing, the district court foreclosed the possibility of balancing other interests implicated in the decision, including those stemming from the functional, identity-conferring, and informational dimensions of the genetic object that are not accommodated under current patent law and doctrine.

While the Federal Circuit and Supreme Court arrived at different legal conclusions than the district court, they too focused their decisions strictly on patent doctrine and policies. Both courts addressed the need (or lack thereof) for patents as an incentive to R&D in the area of genetic testing. And their legal treatment of the genetic objects in dispute was restricted to an IP framework that left no room for any analysis of the other interests raised in the case.

To be clear, we are not suggesting that courts should not engage in patent considerations in cases where a genetic object is part of a product or process that may qualify for patent protection. As initially framed in AMP’s complaint, Myriad was both about interests in genetic objects covered by patents and other interests related to and stemming from these objects. The complaint acknowledged the role of patents under utilitarian IP theories—as incentives to R&D—and patents’ social and economic relevance as recognized by current policy approaches. Still, the complaint argued for balancing patent- and R&D-related interests with other legitimate stakeholder interests. The Myriad courts, however, failed to do so. And in their failure, they ignored the very interests that prompted the lawsuit and that lay at its core. Myriad is, thus, a prime example of how relevant dimensions of genetic objects are ignored because jurists are “boxed” into a particular area of law and lack the mindset, conceptual tools, and terminology necessary to give light to interests implicated by these additional dimensions.

C. The Failures of Maryland v. King

Owing to the identifying power of DNA, the use of genetics in criminal law enforcement has been on a constant rise. As early as the 1980s, states began

171. Id. at 218–20, 222–32, 232–37.
172. Id. at 214.
173. See Myriad Complaint, supra note 161, at 3. The plaintiffs also made the argument, drawn partially from IP theory, that overly broad patent protection also has exclusionary and detrimental effects on R&D, with follow-on researchers being excluded by the patent owner, and they argued that this was the case with Myriad’s prevention of competitors from entering the market. Id. at 25–28.
174. Id. at 3.
enacting laws requiring the collection of genetic samples from individuals arrested for or convicted of violent crimes for inclusion in state databases intended to generate leads in other criminal investigations. And in 1994, the Department of Justice established its own nationwide genetic database known as the Combined DNA Index System (CODIS), which includes genetic profiles of millions of individuals arrested for or convicted of various crimes.

Not unexpectedly, the government’s increased use of genetic tools has raised weighty questions. When does the collection and analysis of genetic samples constitute a search or seizure? Under what circumstances would a search or seizure involving a genetic sample be considered reasonable? What use may be made with the results of genetic analysis in criminal investigation and prosecution? When, if ever, could publicly available information derived from a genetic sample be used to identify a person who has committed a crime? And how should genetic samples obtained during a criminal investigation and information derived from these samples be stored?

The Supreme Court sought to answer some of these questions in its 2013 decision in the matter of Maryland v. King. Under King,

When officers make an arrest supported by probable cause to hold for a serious offense and they bring the suspect to the station to be detained in

177. Id. at 2.
178. Id.
180. See, e.g., King, 569 U.S. at 465–66 (holding that taking a cheek swab of an arrestee’s DNA as part of a police booking procedure is a reasonable search permissible under the Fourth Amendment); see also, e.g., Richard Lempert, Maryland v. King: An Unfortunate Supreme Court Decision on the Collection of DNA Samples, BROOKINGS (June 6, 2013), https://www.brookings.edu/articles/maryland-v-king-an-unfortunate-supreme-court-decision-on-the-collection-of-dna-samples/ [https://perma.cc/QH8V-Q6PD] (examining some of the implications of this decision allowing DNA sampling as part of criminal booking procedure).
184. 569 U.S. 435.
custody, taking and analyzing a cheek swab of the arrestee’s DNA is, like fingerprinting and photographing, a legitimate police booking procedure that is reasonable under the Fourth Amendment.\textsuperscript{185}

But in so holding, the court declined (or neglected) to consider how these actions by law enforcement agencies affect not merely the arrestee’s privacy interests but also other interests of the arrestee and those of groups to which the arrestee belongs and individual members of such groups, who share some of the arrestee’s genetics. The events leading up to \textit{King} began in 2009 when Alonzo Jay King Jr. was arrested in Wicomico County, Maryland, and charged with first- and second-degree assault for pointing a gun at a group of people.\textsuperscript{186} At the time of King’s arrest, the police used a cheek swab to collect his genetic sample pursuant to routine police booking procedures for a serious offense authorized by the Maryland DNA Collection Act.\textsuperscript{187} The police sent the sample for analysis, and three months later, King’s genetic profile was uploaded into the state’s genetic database.\textsuperscript{188} When a routine search of the state’s genetic database matched King’s genetic profile to an unsolved 2003 rape case, King was arrested for that crime.\textsuperscript{189}

King tried to suppress the swab and use of the genetic analysis results, arguing that the routine collection of genetic samples from arrestees charged with (but not yet convicted of) an offense violated the Fourth Amendment, rendering Maryland’s DNA Collection Act unconstitutional.\textsuperscript{190} The Maryland Circuit Court, however, upheld the constitutionality of the Act and refused to suppress the genetic evidence.\textsuperscript{191}

The Maryland Court of Appeals, the state’s highest court, in a divided opinion, disagreed.\textsuperscript{192} Its majority opinion reflected a desire to incorporate into its decision

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\textsuperscript{185}. \textit{Id.} at 465–66 (Scalia, J., dissenting).
\textsuperscript{186}. \textit{Id.} at 440.
\textsuperscript{187}. \textit{King} v. State, 42 A.3d 549, 553 (Md. 2012). The Maryland DNA Collection Act was enacted in 1994, but the provisions of the Act that King challenged, directed to arrestees, were added in 2008. \textit{See Act of May 13, 2008, ch. 377, § 2-504(a), 2008 Md. Laws 3221, 3232.}
\textsuperscript{188}. Under the Maryland DNA Collection Act, the DNA sample is not to be analyzed until the earlier of the date of arraignment or consent from the arrestee, and it must be destroyed if the arrestee is not convicted on the charge(s) leading to the arrest. § 2-504(d)(1). At that time, the DNA sample is analyzed in accordance with FBI’s CODIS standards that were established in response to congressional genetic privacy concerns and are limited to an analysis of 13 loci (20 starting 2017) of noncoding DNA. \textit{See Frequently Asked Questions on CODIS and NDIS}, FBI, \url{https://www.fbi.gov/how-we-can-help-you/dna-fingerprint-act-of-2005-expungement-policy/codis-and-ndis-fact-sheet} [https://perma.cc/MSL3-FDHM]. Once the sample is analyzed, the genetic profile—consisting of a series of numbers representing the genetic variant in each locus—is uploaded to a statewide searchable database or CODIS. \textit{Id.} Law enforcement can then use matches between the arrestee’s genetic profile and profiles stored in the database as probable cause for further investigative measures, including obtaining additional genetic samples from the arrestee and for charging the arrestee with other, unsolved crimes. \textit{See King}, 42 A.3d at 560.
\textsuperscript{189}. \textit{King}, 42 A.3d at 552.
\textsuperscript{190}. \textit{Id.} at 554.
\textsuperscript{191}. \textit{Id.} at 554–55.
\textsuperscript{192}. \textit{Id.} at 555–56 (holding that the Maryland DNA Collection Act, to the extent it permits
consideration of a broader range of interests in the genetic sample while lacking a framework for doing so. The court of appeals openly struggled with the characterization, within the confines of existing law, of the nature and scope of the intrusion into King’s privacy when his genetic sample was taken, analyzed, and used in the genetic database search.  

In a nuanced review, the court considered how other courts in Maryland and elsewhere had conceptualized privacy interests in genetic samples and the information these samples contain. Two competing lines of thinking have emerged from the court’s review. The first focused primarily on the individual-identity-conferring dimension of genetic objects, with a narrow view of what constitutes identity and the interests implicated by law enforcement collection and use of genetic objects. The second reflected a more expansive view of the interests attached to genetic objects. Judges espousing this view tended to characterize the taking and using of genetic objects as more than a minimal invasion of privacy and identity interests of the arrestee and, indeed, as possibly raising more than just privacy concerns. These judges tended to look beyond the state’s alleged interest in using genetic samples merely for identification. They viewed such use primarily as part of an effort to solve crimes while posing a risk of exposing highly sensitive, personal, and potentially humiliating information. But despite acknowledging the broader law enforcement to collect genetic samples from individuals arrested (but not yet convicted) for violent crimes, was unconstitutional.

193. Id. at 552–53. In a second decision, made after the Supreme Court reversed its first decision in this case, the court of appeals ruled that the Maryland DNA Collection Act was constitutional under the Maryland Declaration of Rights. King v. State, 76 A.3d 1035, 1039–42 (Md. 2013).


196. See, e.g., Raines, 857 A.2d. at 45–46 (Raker, J., concurring) (accepting the State’s assertion that a genetic profile is merely a series of numbers tantamount to a Social Security number).

197. See, e.g., id. at 48–49 (“Given the massive amount of deeply personal information that is embodied in the DNA sample, however, it seems to me that a proper analysis of the level of intrusion needs to take that as well into account. A person’s entire genetic makeup and history is forcibly seized and maintained in a government file, subject only to the law’s direction that it not be improperly used . . . .”).

198. Id. at 63 (Bell, J., dissenting) (arguing that it is wrong to characterize the State’s interest served by the search as identification rather than as part of a general effort to solve crimes and rejecting the analogy to a genetic fingerprint because “the DNA search does not
scope of interests implicated by the use of genetic objects in criminal law enforcement and the potential strength of these interests, judges espousing this line of thinking have persistently lacked a clear and legally recognized way of articulating and incorporating these broader interests into their decision-making.

Having informed itself of the landscape of potentially relevant interests at stake, the Maryland Court of Appeals ruled that obtaining and using the cheek swab was an unreasonable search of the person, rendering the DNA taken when King was booked in 2009 an unlawful seizure. Judge Harrell, writing for the majority, focused his objections to the use of King’s genetic sample on concerns about the State’s use of this information to solve other crimes. He emphasized that “[a] DNA sample . . . contains within it unarguably much more than a person’s identity. Although the . . . Act restricts the DNA profile to identifying information only, we cannot turn a blind eye to the vast genetic treasure map that remains in the DNA sample retained by the State.”

Judge Harrell also flagged the dangers that attach to systems of collecting and retaining DNA samples. Ultimately, however, the court of appeals’ decision was chiefly driven not by the broader interests implicated by the use of the genetic sample but by the fact that the true motivation behind its collection was searching for matches to other unsolved cases in the genetic database.

The U.S. Supreme Court’s subsequent opinion in King shared none of the nuances of the Maryland Court of Appeals opinion. Although the Court acknowledged the legal challenges posed by advancements in genetic technology, the opinion completely bypassed any consideration of the nature and scope of interests in genetic samples retained in police custody. Writing for the majority, Justice Kennedy simply held that the law enforcement practices in dispute constituted a legitimate end with the swab. To the contrary, the swab is then subjected to scientific tests, which may extract very sensitive, personal, and potentially humiliating information.”


200. Id. at 552 (“King, who was arrested, but not convicted, at the time of his first compelled DNA collection, generally has a sufficiently weighty and reasonable expectation of privacy against warrantless, suspicionless searches that is not outweighed by the State’s purported interest in assuring proper identification of him as to the crimes for which he was charged at the time.”).

201. Id. at 577.

202. Id. (“A person’s entire genetic makeup and history is forcibly seized and maintained in a government file, subject only to the law’s direction that it not be improperly used and the prospect of a misdemeanor conviction if a custodian willfully discloses it in an unauthorized manner. No sanction is provided for if the information is non-willfully disclosed in an unauthorized manner, though the harm is essentially the same.” (emphasis in original)).

booking procedure that was reasonable under the Fourth Amendment.\textsuperscript{204} He emphasized the limited scope and nature of arrestees’ interest in how their genetic samples were used.\textsuperscript{205} And he framed law enforcement’s collection and analysis of genetic samples as a minimal invasion of privacy, no different from other routine methods of identifying arrestees.\textsuperscript{206}

Viewed through the lens of our framework, the Supreme Court’s decision in \textit{King} wrongly focused exclusively on balancing the State’s interests stemming from the individual-identity-conferring dimension of the genetic object with those of the arrestee. This narrow view of the interests at stake ignored any potential interests stemming from the informational and group-identity-conferring dimensions of the genetic object.\textsuperscript{207} It allowed Justice Kennedy to espouse a similarly narrow view of the issue as purportedly limited to identification, where a simple preference of the State’s interest dictated the outcome of the case.\textsuperscript{208} To the Supreme Court majority, the genetic profile generated from an arrestee’s genetic object was just "another metric of identification used to connect the arrestee with his or her public persona, as reflected in records of his or her actions that are available to the police."\textsuperscript{209}

Justice Scalia’s dissent was similarly narrow in its approach, focusing on how the genetic sample was used to identify perpetrators of unsolved crimes.\textsuperscript{210} Like the majority, Justice Scalia did not mention any of the interests stemming from a genetic sample’s group-identity-conferring, physical-chemical, and informational dimensions as something to consider. In short, neither opinion in \textit{King} considered any interests beyond the State’s interests in confirming the identity of arrestees and using that information to solve crimes, and the interests of arrestees in not having their identity confirmed for use in solving other crimes.

Had the Supreme Court applied our framework to \textit{King}, it might have reached a different result. Correctly identifying the genetic object—the genetic sample taken from King, not the summarized genetic analysis results—as well as acknowledging

\textsuperscript{204} \textit{King}, 569 U.S. at 465–66.
\textsuperscript{205} \textit{Id.} at 446 (holding that “the framework for deciding the issue [of use of genetic technology as a routine part of booking procedures] is well established” and easily analogized to other methods of identifying arrestees, with corresponding limited expectations of privacy on the part of the arrestee).
\textsuperscript{206} \textit{Id.} at 461 (“[T]he intrusion of a cheek swab to obtain a DNA sample is a minimal one.”); \textit{Id.} at 464 (“A brief intrusion of an arrestee’s person is subject to Fourth Amendment concerns, but a [buccal cheek] swab of this nature does not increase the indignity already attendant to normal incidents of arrest.”).
\textsuperscript{207} \textit{See supra} Parts II.B.2 and II.B.5, respectively.
\textsuperscript{208} To support this approach, Justice Kennedy relied heavily on analogies to other identifying technologies (e.g., to fingerprints) to frame and justify his treatment of genetic objects in criminal enforcement. After reasoning that a “suspect’s criminal history is a critical part of his identity that officers should know when processing him for detention,” Justice Kennedy went on to argue that “the only difference between DNA analysis and the accepted use of fingerprint databases is the unparalleled accuracy DNA provides.” \textit{King}, 569 U.S. at 450–51, 478.
\textsuperscript{209} \textit{Id.} at 451.
\textsuperscript{210} \textit{Id.} at 480 (Scalia, J., dissenting) (“What DNA adds—what makes it a valuable weapon in the law-enforcement arsenal—is the ability to solve unsolved crimes, by matching old crime-scene evidence against the profiles of people whose identities are already known.”).
and weighing the interests stemming from its individual-identity-conferring, group-identity-conferring, physical-chemical, and informational dimensions would have required the Court, at the very least, to acknowledge the broader range of stakeholder interests and weigh them against the law enforcement interests the Court found compelling.

Consider, for example, the physical-chemical and informational dimensions of the genetic sample. To retain custody of a genetic sample is to retain more than a mere identifier. It is to possess something that was once part of a person and is a blueprint of that person’s genealogy and genetic traits. And, as recognized by Judge Harrell, it contains a staggering amount of information about that person and their relatives that is immensely more sensitive and vast than the information contained in fingerprints. While removing a genetic sample may seem relatively easy and painless in the context of criminal enforcement, it might seem more intrusive when viewed in this light. Similarly, the majority seemed content to rely on the government’s assertion that the genetic identifiers used in genetic databases were of “junk DNA,” conveying no information beyond as a marker of identity. But considering this assertion in the context of the group-identity-conferring dimension of the genetic sample forces the recognition that “junk DNA” may reveal information about a person and their relatives well beyond the identity of the person from whom the genetic material was taken.

Considering the interests of the arrestee’s familial, ethnic, and racial groups could also have made the Supreme Court take notice of broader concerns. Membership in such groups bears an increased risk of being implicated in crimes—sometimes falsely—borne by members of such groups, which has the potential to exacerbate the effects of existing biases within the criminal justice system. Moreover, using

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211. See supra Parts II.B.1 and II.B.2, respectively.
212. As we have known since the early 2000s, a typical human genome contains about three billion pairs of nucleotides and more than 20,000 genes of which at least 1400 are associated with known genetic diseases and has more than three million known locations of individual genetic variations. See International Consortium Completes Human Genome Project, NAT’L HUM. GENOME RSCH. INST. (Apr. 14, 2003), https://www.genome.gov/11006929/2003-release-international-consortium-completes-hgp [https://perma.cc/EF9F-6KXJ]. The number of things knowable from a person’s DNA was already large in the early 2010s—when King was decided—and keeps growing. See generally Introduction to Genomics, NAT’L HUM. GENOME RSCH. INST. (May 8, 2012), https://www.genome.gov/About-Genomics/Introduction-to-Genomics#four [https://perma.cc/2H9D-ESU4].
214. See Lempert, supra note 180, at 3 (“The difficulty in justifying King is still greater when one considers that the police do not arrest innocent people at random. Minorities appear particularly vulnerable. . . . [and even] people who have never done anything to justify having their DNA typed are effectively in the DNA data base, and racial disparities in the likelihood of arrest will be reflected in the degree to which never-arrested members of different ethnic groups are vulnerable to DNA identification.”).
genetic samples taken from arrestees in a system already characterized by racial bias can further enhance these biases, causing society-wide effects.215 Once these and other interests were acknowledged, even if the Supreme Court continued to afford little weight to King’s own interests, it likely would not have been able to dismiss the interests of King’s family and racial group members as easily. With the more extensive range of interests attached to King’s genetic sample and its use in mind, the Court’s Fourth Amendment balancing of interests may well have been tilted in favor of more significant limits on the use of genetic samples by law enforcement.

Events after King involving the use of genetic technology in law enforcement (e.g., the use of consumer genetic databases to identify criminals through genetic samples taken from relatives) have further exposed the limitations of the Supreme Court’s approach in that case.216 Cases like that of the Golden State Killer217 continue to raise weighty questions about the use of public and private genetic databases by law enforcement and expose the limitations of the Supreme Court’s narrow focus on just a few interests stemming from only one dimension of genetics.

D. The Failures of the Genetic Information Nondiscrimination Act (GINA)

The 2008 enactment of the Genetic Information Nondiscrimination Act (GINA)218 represented the culmination of a political movement and vigorous legislative efforts to address concerns regarding genetic discrimination that originated in the mid-1990s (or 1970s, depending on one’s perspective).219 It was significant for several reasons. GINA constituted the first federal legislative response to the growing need to protect interests implicated by developments in genetic science and technology.220 It explicitly articulated the need for a departure from the patchwork approach to regulating genetics state-by-state.221 And it created, for the first time, substantive protections in federal law against discrimination based on an individual’s genetic information in health insurance222 and employment.223

215. See id.

216. See, e.g., Natalie Ram, Fortuity and Forensic Familial Identification, 63 STAN. L. REV. 751 (2011) (writing before the Supreme Court’s decision in King but addressing the need to resolve the question of how states ought to use genetic databases in criminal investigations).


221. GINA § 2(5).

222. Id. §§ 101–106.

223. Id. §§ 201–213.
GINA was celebrated as “the first major new civil rights bill of the new century.” Although its enactment took over a decade of campaigning, GINA reflected a rare broad consensus among lawmakers and policymakers: it received a unanimous favorable vote in the Senate (94 to 0) and a nearly unanimous favorable vote in the house (414 to 1). Even more impressively, as underscored by legal scholar Eric Feldman, “GINA enjoyed [this] overwhelming Congressional support . . . despite its novelty.”

GINA’s broad bipartisan support might not seem as surprising when viewed from a historical perspective. GINA’s enactment took place shortly after the conclusion of the Human Genome Project—a time of rapid scientific and technological breakthroughs in genetics. As such, it was driven, at least partly, by a shared concern that fears of genetic discrimination might hinder the growth of what many expected to be a new era of personalized genomics. GINA’s enactment, therefore, represented a uniquely proactive approach to addressing concerns about discriminatory uses of genetic information.

When viewed in this light, GINA can be regarded as a well-crafted response to emerging problems posed by the expansion and application of genetic science—a positive first step towards recognizing people’s interests in their genetic information and providing individuals with some protection against an unfettered use of genetic information in certain contexts. Yet, despite its achievements, from the outset GINA’s statutory scheme had some significant shortcomings that have persisted over time and which have been widely debated by legal scholars and argued over in courts. For instance, even within GINA’s limited contexts of insurance and employment, the Act only protects against genetic discrimination in employment and health insurance while not providing similar protections for individuals seeking life, disability, and long-term care insurance. Further, GINA’s protections only apply...
to asymptomatic individuals and do not extend to cases where discriminatory conduct is based on “a manifested disease, disorder, or pathological condition.”

GINA’s compatibility with the Americans with Disabilities Act (ADA) also presents problems. While GINA prohibits employers from requesting, requiring, or purchasing employees’ genetic information, the ADA allows employers to acquire such information when they obtain access to potential employees’ health records once a conditional employment offer under the ADA is made.

But GINA also reflects the broader failure of lawmakers to adequately discern, categorize, and consider the multifaceted interests in genetic phenomena, including interests stemming from dimensions of genetic objects beyond those involving genetic information. With the benefit of hindsight, GINA can be viewed as a reaction to a narrowly defined, largely anticipated harm (in this case, employment


236. GINA § 202(b).

237. 42 U.S.C. § 12112(d); see Rothstein, supra note 234, at 837–38; Rothstein, GINA in Context, supra note 41, at 656; Mark A. Rothstein, Predictive Health Information and Employment Discrimination Under the ADA and GINA, 48 J.L. MED. & ETHICS 595, 598–99 (2020).

238. The GINA bill “competed” with numerous other bills introduced between 1995–2007 that sought to address genetic discrimination in employment and healthcare insurance settings. See Roberts, supra note 219, at 447–48 nn.32, 36–41 (listing such bills). However, practically all of these competing bills focused almost exclusively on the same issues as GINA: genetic discrimination in the context of employment and health insurance. The only exception was a bill sponsored by the late Senator Pete Domenici (R-NM) in 1996 and then again in 1997, which sought to address a somewhat broader set of issues implicated by genetic testing technology. See Genetic Confidentiality and Nondiscrimination Act of 1996, S. 1898, 104th Cong. (1996); Genetic Confidentiality and Nondiscrimination Act of 1997, S. 422, 105th Cong. (1997). Although Sen. Domenici’s bill reflected broader thinking about potential legal implications of genetic technology, it too suffered from many of GINA’s (and the other bills’) shortcomings, which we discuss below. After being introduced, both Senator Domenici’s bills were referred to the Senate’s Labor and Human Resources Committee where they died. See CONGRESS.GOV, https://www.congress.gov/bill/104th-congress/senate-bill/1898/conferences [https://perma.cc/H4HH-M7NN]; CONGRESS.GOV, https://www.congress.gov/bill/105th-congress/senate-bill/422/conferences [https://perma.cc/8J2U-7A7W].

239. See Rothstein, supra note 219, at 175 (noting that the legislative efforts that have led to GINA “prec[ed] any evidence of significant discriminatory conduct by health insurers or employers” but recognizing there was evidence of avoidance of genetic testing by potentially
and healthcare insurance discrimination) stemming from a limited set of uses of a specific genetic technology (in this case, genetic testing) in a specific setting (in this case, employment and health insurance). The starting point for such legislation is an attempt to address a particular harm—an “end-of-the-pipeline” approach, so to speak—rather than contemplation of the broader interests implicated by the technology. And its endpoint is an ad hoc solution to a small number of concerns related to a narrow subset of interests in genetic objects. The result of this narrow focus is an ongoing struggle with defining and protecting interests in genetic objects, including interests in “genetic information,” and with how to justify this disparate treatment.

This struggle, we suggest, is fueled at least in part by the absence of a legal framework for clearly articulating what interests need to be considered, reflected, and protected in legislation involving genetic objects. The absence of such a framework results in missed legislative opportunities to examine and appropriately balance the myriad of interests implicated by genetic technologies and their uses.

240. See Slaughter, supra note 239, at 49 (describing the impetus for and how she conceived of GINA).

241. The same tendency to focus on a narrow set of discriminatory practices involving genetic information has also driven much of the state-by-state genetic legislation that preceded and followed GINA. See Roberts, supra note 219, at 446 nn.27–28 and accompanying text; Prince, supra note 41, at 198–201 (surveying state genetic privacy legislation); see also infra note 291.

242. See Rothstein, supra note 219, at 177 (arguing that “[t]he main value of GINA is its symbolism”).

243. See supra note 44; Suter, supra note 232, at 498–500 (discussing a dispute regarding the proper interpretation of the term “genetic information” under GINA); Corbett, supra note 239, at 4, 10–11, 16 (expressing puzzlement at GINA’s enactment and describing it as a “nonprototypical (mutant) . . . hybrid privacy-antidiscrimination law” and predicting GINA “will have little practical usefulness and the likes of which we may never see again”).

244. See Rothstein, Gina in Context, supra note 41, at 656 (expressing concern that GINA might delay the enactment of effective genetic rights legislation). But see Slaughter, supra note 239, at 59 (responding to this critique by arguing that “GINA remains an important step towards freedom from insidious discrimination, but it is by no means the end point. Just as
GINA, for example, emerged as the product of specific concerns involving genetic privacy and the opportunity for employment and healthcare insurance discrimination. As such, it lacked the potential benefits of being the product of a thought process focused on genetic objects implicated by genetic testing and sequencing technology, the multiple dimensions of such objects, the interests they invoke, and the appropriate interventions to protect these varying interests.

To illustrate, although GINA protects some individual and familial interests in genetic information, it fails to acknowledge the possible interests of broader groups. And although it seeks to stave off genetic discrimination or the risk of such discrimination, it neglects to address conceivable forms of genetic discrimination that may occur outside the work and insurance settings. Similarly, GINA does not acknowledge or negate other interests implicated by genetic testing technology, such as the interest in accessing one’s own genetic information (which could have preempted Myriad), interests in controlling access to individual and group genetic information, particularly vis-à-vis government entities (which could have resolved King), possible interests in or related to benefits arising from genetic objects originating from one’s body (which could have been informed by Moore and Greenberg), and more.

access to all civil rights developed in stages, a first step was taken with the passage of GINA, but it was only the first step. Clearly more work is needed to protect the American people."

245. See Areheart et al., supra note 229, at 723 (“GINA thus represents a very specific response to a very specific problem.”).

246. See 42 U.S.C. § 300gg-91(d)(15) (defining “Family member”); Leib-Neri et al., supra note 83 (proposing a concept of “intimate genetic communities” that have shared interests in the contexts of genetic testing and genetic data privacy).

247. See e.g., Prince, supra note 41, at 177–78 (“With the burgeoning use of genetic testing and advances in understanding hereditary links for disease, laws need to address how the broader society—from government to educational institutions to researchers to nosy neighbors—can use an individual’s genetic information in contexts outside of health insurance and employment.”); see id. at 208–11 (criticizing state genetic rights legislation as overbroad and insufficiently specific to address individuals’ concerns involving their genetic information and mentioning California’s GINA-like legislation as providing stronger protections against genetic discrimination); Jessica L. Roberts, The Genetic Information Nondiscrimination Act as an Antidiscrimination Law, 86 NOTRE DAME L. REV. 597, 610–11 (2011) (describing additional situations in which genetic discrimination could, hypothetically, take place).

248. To clarify, the interest we discuss here, which is the interest in knowing one’s genetics as part of the interest in knowing oneself, is broader than the interest in accessing healthcare records containing genetic information, which is recognized as a right under GINA. See Genetic Information Nondiscrimination Act of 2008, Pub. L. No. 110-233, 122 Stat. 881, 890 (2008) (codified in 42 U.S.C. § 300gg-91(d)(15)-(18)); see also Evans, supra note 239, at 2074–80 (discussing GINA’s institution of a right to access one’s own genetics as part of the right to access one’s health records under the Health Insurance Portability and Accountability Act of 1996 (HIPAA)).

249. See Prince, supra note 41, at 182–83, 185–92, 211–16 (enumerating areas of concern and property and privacy interests that remain unaddressed by GINA, discussing unaddressed interests vis-à-vis surreptitious genetic testing and avoidance of disclosure of genetic information); Heled et al., supra note 7, at 418.

250. This is not to say Moore, the Canavan Families, and other similarly situated plaintiffs necessarily deserve legal recognition in an ownership interest in genetic objects derived from
While any law—let alone federal law—is the product of compromise, GINA’s scope may well have been limited not just by the need for compromise but also by the absence of a clearly articulated description of the interests, and harms, at stake. Much like courts have lacked the concepts and terminology to account for the gamut of interests in genetic objects, so, we contend, have GINA’s drafters and sponsors. GINA, therefore, illustrates the consequences of a legal approach to genetics that lacks the concepts and terminology to account for the broad range of interests in genetic objects.

The framework proposed in this article offers an opportunity to inform a robust discussion that would enable legislators to consider (even if not always enact) comprehensive legislation addressing various interests related to genetic objects in a broader range of scenarios. We recognize the difficulty of mapping dimensions of genetic objects and associated interests with potential legal salience into the legislative process, especially when the underlying science and technology are undergoing profound changes. We are also not blind to the reality of legislative efforts often being far from the robust deliberative processes we wish they were. However, nonengagement in a broader conceptual discussion of the range of interests in genetic objects affected by new technology is bound to translate into a patchwork of ad hoc narrow legislative interventions—precisely what GINA sought to avoid. If only some of the participants—be it legislators, regulators, staffers, aides, drafters, or expert witnesses testifying before a committee—employ our framework, that their bodies or those of their kin. Nonetheless, we contend that such individuals and groups do have legitimate interests in such objects that ought to receive some legal recognition under certain circumstances. For example, when the genetic objects, derivatives thereof, and products made from such objects (e.g., cell lines, therapeutics) become valuable commercially, such interests might entitle the originator individuals and groups to “royalties” from commercial sales involving the objects, derivatives, and products. In other cases, such interests may entitle the originator individual and groups to “attribution” similar to that afforded to artists under the Visual Artists Rights Act (VARA). See 17 U.S.C. § 106A(1)(A) (“[T]he author of a work of visual art [] shall have the right [] to claim authorship of that work.”). These are, of course, just examples. Our proposed framework should allow jurists to conceive of others.

251. GINA’s bill evolution and its prevailing over numerous other “competing” genetic rights bills introduced during the 104th through 109th Congresses is certainly the product of legislative compromise. See Slaughter, supra note 239, at 48–55 (describing GINA’s shaping into its final form through legislative negotiations and redrafting); Roberts, supra note 219, at 447–51 (explaining how GINA overcame well-organized, determined, and ongoing opposition).

252. Legislative efforts pertaining to biotechnologies are particularly susceptible to deficiencies stemming from legislators’ lack of understanding of scientific and technological subject matter and coordinated misinformation campaigns by well-funded, entrenched interest groups (e.g., the reproductive industry and pharmaceutical industry). See, e.g., Michael Rodemeyer, Daniel Sarewitz & James Wilsdon, The Future of Technology Assessment 10 (2005) (explaining the problem of Congressional reliance on external scientific and technical advice). See generally Albert C. Lin, Revamping our Approach to Emerging Technologies, 76 Brook. L. Rev. 1309 (2011) (highlighting deficiencies in assessment of biotechnologies in the United States).

253. See supra notes 220–21 and accompanying text.
would have the potential to give the process the broader perspective that genetic phenomena require.

E. Further Illustrations of Genetic Dimensions Unseen and Interests Ignored

The struggle to accommodate new legal questions raised by genetics within the law is not limited to the areas discussed above but pervades an ever-growing range of bodies of law. In this section, we briefly illustrate the expanding scope of legal contexts in which genetic phenomena come up and highlight some additional examples of genetic interests that are not fully captured under existing legal approaches. 254

1. Ciccone v. Gotta Have It! Collectibles, Inc.

The pop singer Madonna Ciccone (a.k.a. Madonna) is an outlier, and perhaps a forerunner, in her concern for unprotected interests in her genetic objects. She has long been known to take steps to protect her genetic material from uninvited prying by “genetic paparazzi.” 255 Therefore, when an auction house put up for sale her used hairbrush with some of her hairs still attached, it was no surprise that Ciccone sued to enjoin the sale and regain possession of her genetic object. 256 But when Ciccone’s case came before a New York state court, the court focused its discussion exclusively on the disposition of the hairbrush itself, as though no genetic object was implicated, 257 and rejected Ciccone’s claims without addressing her concerns.

254. Due to editorial constraints, a fuller treatment under our framework of the examples below is not possible within the confines of this article, and we leave such treatment for later work. However, the limited treatment of these examples here is not meant to imply we consider these cases as less important or worthy of discussion and their inclusion in this article is merely intended to illustrate the growing number of legal contexts in which genetics increasingly present challenges to existing legal frameworks and mindsets.

255. See, e.g., Clemmie Moodie, Madonna Appoints a DNA Team to Sterilise Her Dressing Room After She’s Used It, MIRROR (June 23, 2012), https://www.mirror.co.uk/3am/weird-celeb-news/madonna-appoints-dna-team-sterilise-907641 [https://perma.cc/L33V-J5RA]; Ben Locwin, Madonna May Suffer From ‘DNA Paranoia’, GENETIC LITERACY PROJECT (Feb. 19, 2016), https://geneticliteracyproject.org/2016/02/19/madonna-may-suffer-dna-paranoia/ [https://perma.cc/X8AN-APU2]; Heled et al., supra note 7, at 418 (discussing the idea of “genetic paparazzi”). See generally Rothstein, supra note 43 (providing a comprehensive analysis of the legality of what he calls “genetic stalking and voyeurism”).


regarding the genetic object. The appeal court affirmed the trial court’s order, again without mentioning Ciccone’s concerns surrounding the genetic object.

It is unclear why both courts failed to address Ciccone’s interests in the genetic object or even mention its presence in their discussion of the disposition of the hairbrush. Perhaps, like the defendants, the courts considered Ciccone’s concerns whimsical or a ruse. Perhaps the courts did not see a way to address the interests implicated by Ciccone’s concerns within the confines of the legal “boxes” of her conversion and replevin claims. Or perhaps it never occurred to the courts that the genetic object ought to have been considered separately from the hairbrush, and its disposition possibly decided under a different set of rules. Whatever the reason, the outcome has arguably undercut Ciccone’s valid interests in the genetic object without acknowledging such interests even existed.

The Ciccone case is, therefore, an excellent (and recent) example of misidentification and mistreatment of a genetic object in a court case. It is also a concerning harbinger of things as genetic testing capabilities become more readily available and the likelihood of surreptitious genetic testing becomes a reality, especially for public figures.

2. Havasupai Tribe of Havasupai Reservation v. Arizona Board of Regents

Members of the Havasupai Tribe, a small Indian community located in the basin of the Grand Canyon, approached an anthropology professor named John Martin at Arizona State University (ASU) in 1989, seeking to learn why the incidence of diabetes in their community was so devastatingly high. To secure funding for the research, Martin recruited ASU geneticist Therese Markow, a schizophrenia genetics specialist, who agreed to provide some immediate funding to the project. Researchers from ASU subsequently collected DNA samples from more than two

258. Id.
260. See Memorandum of Law in Opposition to Plaintiff’s Motion for a Preliminary Injunction and in Support of Defendants’ Motion to Dismiss and for Sanctions at 25, Ciccone v. Gotta Have It! Collectibles, Inc., No. 156454/2017, 2018 WL 1911932, (N.Y. Sup. Ct. Apr. 23, 2018) (arguing that Madonna “has given away so many pairs of her used underwear over the years . . . and never before has she made an effort to protect her DNA from being extracted from those, or other personal items that she freely gave away”).
hundred Tribe members as part of a project the Tribe understood as a search for genetic clues to its members’ high rate of diabetes.\footnote{Id. at 1067; Sterling, supra note 262, at 115.}

Even though the Havasupai Tribe had not consented, and was unlikely to consent, to a study on mental disorders, Dr. Markow applied for and was granted funding to research schizophrenia within the Havasupai Tribe.\footnote{Kristof Van Assche, Serge Gutwirth & Sigrid Sterckx, Protecting Dignitary Interests of Biobank Research Participants: Lessons from Havasupai Tribe v. Arizona Board of Regents, 5 LAW INNOVATIONS & TECH. 54, 57 (2013).} The researchers then used funds from the schizophrenia project to pay for the collection of the first set of blood samples.\footnote{Havasupai Tribe, 204 P.3d at 1079.} The documentation on informed consent signed by the members of the Tribe participating in the research was drafted broadly as targeting medical and behavioral disorders, but no member or representative of the Tribe was told that the research would have any other purposes besides the study of diabetes.\footnote{Van Assche et al., supra note 265, at 57–59. This approach reflects a view prevalent in the scientific community about the benefits of unencumbered biomedical research, as well as the tendency to ignore or downplay other individual and group interests attaching to the research materials. See Harmon, supra note 262; see also Michelle M. Mello & Leslie E. Wolf, The Havasupai Indian Tribe Case—Lessons for Research Involving Stored Biologic Samples, 363 N. ENG. J. MED. 204 (2010) (discussing ways of avoiding similar disputes involving informed consent in the future).}

While early research performed at ASU on the Havasupai genetic material showed no genetic predisposition to diabetes, researchers continued to use the samples for research on schizophrenia and inbreeding.\footnote{Havasupai Tribe, 204 P.3d at 1067.} When Dr. Markow moved to a different academic institution, the University of Arizona (UA), she took the blood samples with her and continued using them, including in further research on population migration, and sharing the samples with colleagues at other universities.\footnote{Van Assche et al., supra note 265, at 59.} This constituted a further violation of the agreement signed by the Tribe, which stated that no data or other information about the Tribe’s genetic material would be shared beyond ASU.\footnote{Id.}

In March 2003, some members of the Havasupai Tribe became aware that their genetic material was being used in research to which they had not given consent.\footnote{Id. at 1067–68.} The Havasupai Tribe issued a banishment order to prevent ASU researchers and other ASU employees from entering the reservation and filed several notice-of-claim letters arguing that their blood samples had been misused.\footnote{Id. at 1068–69.} The Tribe argued that the misuse of the samples constituted an invasion of both their individual and collective privacy—specifically, the Tribe’s “cultural and religious privacy”—inflicted harm and emotional distress on the Tribe, and contributed to increased sentiments of mistrust of medical research and health care.\footnote{Id. at 1067–68.}

Shortly after that, in 2004, fifty-two members of the Havasupai Tribe who had provided blood samples sued the Arizona Board of Regents, the governing body in
charge of both ASU and UA.274 The Havasupai Tribe brought its own separate lawsuit and in parens patriae.275 Collectively, the claims alleged a breach of fiduciary duty, lack of informed consent, fraud and misrepresentation, fraudulent concealment, intentional infliction of emotional distress, negligent infliction of emotional distress, conversion, violation of civil rights, negligence, negligence per se, and gross negligence, for a total of $60 million.276

From the outset, though, the Tribe’s claims were plagued with legal challenges by the defendants and difficulties in articulating and establishing actionable harms. Specifically, for example, the Havasupai attach spiritual significance to their blood, and their tribal origin story is in tension with what studies of their genetics tend to reveal.277 Nonetheless, in its claims, the Tribe continuously struggled with articulating and establishing the injuries to these interests—which stem from the individual- and group-identity-conferring dimensions278 of the blood samples—within the conceptual and terminological confines of existing privacy, informed consent, and property laws.

The protracted litigation between the parties continued for seven years, and in 2010 the parties eventually settled.279 The Arizona Board of Regents agreed to pay the Tribe $700,000 and return to the Tribe the remaining blood samples and any documentation related to the research on the samples.280

This litigation, and the decisions made by researchers that fueled the litigation in the first place, provide yet another illustration of the law’s recurring failure to acknowledge and respond to interests that attach to routinely “unseen” facets of genetic objects. In particular, the Havasupai Tribe case demonstrates how both individuals that contribute a blood sample and the groups to which they belong have enduring interests not just in the discrete information extracted from their genetic objects but also in the relational, identity-conferring dimensions of such objects, which link research participants and nonparticipants as members of larger and often deeply connected groups.

274. Id. at 1070–71.
275. Id. at 1070.
276. Van Assche et al., supra note 265, at 61.
277. See 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 & BIOMEDICAL L. 175, 214 (2010) (“[T]he Havasupai tribe believes that biological materials must be intact to cross from the physical world to the spirit world. . . . [T]he return of blood [from ASU] therefore meant that the tribe could properly bury the blood with the deceased individuals, so the deceased could finally enter the spirit world.”); cf. Charles Petit, Trying to Study Tribes While Respecting Their Cultures: Hopi Indian Geneticist Can See both Sides, SFGATE. (Feb. 19, 1998), at https://www.sfgate.com/news/article/Trying-to-Study-Tribes-While-Respecting-Their-3012825.php [https://perma.cc/5TN3-WUW5] (quoting Dr. Frank Dukepoo, a member of the Hopi Tribe and a geneticist, explaining that “[t]o us, any part of ourselves is sacred. Scientists say it’s just DNA. For an Indian, it is not just DNA, it is part of a person, it is sacred, with deep religious significance. It is part of the essence of a person.”).
278. See supra Parts II.B.6 and II.B.5, respectively.
279. See Sterling, supra note 262, at 115.
280. Id.
3. Lawsuits Involving Reproductive Wrongdoing

The use of assisted reproductive technologies (ART) has dramatically increased over the last several decades, and with it came lawsuits against sellers of reproductive tissue and providers of ART services (“ART lawsuits”). ART lawsuits are typically brought by parents of children conceived using ART and often involve claims of wrongdoing by sellers of reproductive tissue and providers of ART services resulting in the birth of children different from the plaintiff-parents’ expectations. Therefore, the claims raised in ART lawsuits frequently implicate


283. See, e.g., Ashby v. Mortimer, No. 4:18-cv-00143-DCN, 2020 U.S. Dist. Lexis 21622, at *5 (D. Idaho 2020) (alleging that instead of inseminating the plaintiff with the sperm of an anonymous donor as discussed, the defendant physician used his own semen); Harnicher v. Univ. of Utah Med. Ctr., 962 P.2d 67, 68 (Utah 1998) (alleging that fertility clinic used the wrong sperm from a donor who did not resemble the legal father as the couple had originally intended, resulting in emotional distress); Donovan v. Idant Lab’ys, 625 F. Supp. 2d 256, 262–63 (E.D. Pa. 2009), aff’d, 374 F. App’x 319 (3d Cir. 2010) (asserting various claims against a
interests that plaintiff-parents have in the genetic makeup of the reproductive tissue used to conceive their children.\textsuperscript{284}

Like in other cases described in this article, courts have frequently rejected ART lawsuits by ignoring, downplaying, and even casting down the interests of plaintiff-parents in the genetic objects used in their ART procedures.\textsuperscript{285} Courts seem to be particularly hostile toward such lawsuits for at least two reasons.\textsuperscript{286} First, many judges loathe casting children as a legal injury and dread the possible implications of allowing recovery on the children’s self-esteem and relationships with the plaintiff-parents.\textsuperscript{287} The role of abortion politics as at least one driving force behind

sperm bank for its failure to diagnose a sperm donor as the carrier of Fragile X Syndrome resulting in the manifestation of the disorder in the girl conceived with the donor’s sperm); Cramblett v. Midwest Sperm Bank, LLC, No. 2–16–0694, 2017 WL 2800062, at *1 (Ill. App. Ct. June 27, 2017) (alleging sperm bank’s mistake resulted in the birth of a mixed-race, rather than Caucasian, child); Zelt v. Xytex Corp., 766 F. App’x 735, 737 (11th Cir. 2019) (asserting various claims against a sperm bank for misrepresentations related to sperm donor, which have led to the birth of children having an increased risk of developing mental illnesses). Prof. Dov Fox classifies cases involving such claims as “procreation confounded” and distinguishes them from cases of “procreation imposed” and “procreation deprived.” See DOV FOX, BIRTH RIGHTS AND Wrongs 127–40 (2019).


285. Particularly salient examples of this phenomenon are ART lawsuits involving children that are genetically different from their parents’ expectations but otherwise healthy. See, e.g., Harnicher, 962 P.2d at 71–72 (holding that since the children—while having unintended parentage due to being conceived using different sperm than that intended—were not “unhealthy, deformed, or deficient in any way,” and there was no “racial or ethnic mismatch between the triplets and their parents” plaintiffs did not suffer a legally cognizable injury); id. at 72 (disparaging the plaintiff-parents’ complaint stating that “[e]xposure to the truth about one’s own situation cannot be considered an injury and has never been a tort”); Andrews v. Keltz, 838 N.Y.S.2d 363, 369 (App. Div. 2007) (holding that “[p]lainiffs cannot recover damages based upon their claim that they were deprived of the opportunity to have a child of their own genetic makeup”). See also FOX, supra note 283, at 65 (discussing plaintiffs’ difficulty in recovering for emotional harm under tort law theories in cases involving claims for missing embryos, switched donors, and failed birth control when unable to show “present and demonstrable physical injury”).

286. For additional reasons, see FOX, supra note 283, at 127–64.

287. See, e.g., Andrews, 838 N.Y.S.2d at 367 (quoting Weintraub v. Brown, 470 N.Y.S.2d 634 (App. Div. 1983)) (holding that “we are unable to hold that the birth of an unwanted but otherwise healthy and normal child constitutes an injury to the child’s parents . . . . We are loath to adopt a rule, the primary effect of which is to encourage, indeed reward, the parents’ disparagement or outright denial of the value of their child’s life”” in a case involving sperm
such court hostility is rarely explicit but cannot be denied. Second, courts are unwilling to support what some judges seem to view as parent-plaintiffs’ vain pursuit of “better” children and the potential eugenic implications of such a pursuit. But in their hostility toward ART lawsuits, courts fail to recognize or even acknowledge parents’ interests stemming from the reproductive and group-identity-conferring dimensions of the genetic objects underlying the parents’ claims.

We recognize that applying our proposed framework might not change the outcome in at least some ART lawsuits. Our proposed framework will not change that reality and cannot guarantee courts will change their attitudes toward ART lawsuits. Still, our framework offers neutral terminology and an analytical method that would allow courts to acknowledge and properly consider plaintiff-parents’ interests in the genetic objects they use to conceive their offspring and, ultimately, in the genetic characteristics of their children.

F. Drawing Broader Lessons

The cases and legislation discussed above illustrate the ramifications of the absence of a framework for considering genetic phenomena in legal contexts. As a result of this absence, courts and lawmakers rely primarily on existing legal categories and terminology from property law and privacy law frameworks when addressing issues involving genetic objects. When genetic objects are the subject of commercial interests, jurists tend to approach matters involving these objects under property law categorizations. The Moore, Greenberg, and Myriad cases illustrate this phenomenon. And so do state laws that recognize individuals’ enduring interests in the physical-chemical and informational dimensions of their genetic objects by mix-up); Zelt v. Xytex Corp., No. 1:17-CV-4851-TWT, 2018 WL 1014627, at *3 (N.D. Ga. 2018) (dismissing claims against a sperm bank because “Georgia courts are unwilling to say that life, even life with severe impairments, may ever amount to a legal injury”) (internal quotations omitted); Norman v. Xytex Corp., 848 S.E.2d 835, 841–42 (Ga. 2020) (in a case involving multiple claims for damages stemming from the birth of a child suffering from medical conditions inherited from a sperm donor, disallowing claims for damages that would cast the life of the child as an injury); see also Fox, supra note 283, at 160–64.


290. See supra Parts II.B.7 and II.B.5, respectively.
making particular genetic objects or a specific aspect of genetic objects the property of the persons from whom the objects originated.291

The relative salience of genetic objects’ physical-chemical and informational dimensions may help explain jurists’ tendency to approach commercial interests in genetic objects through a property lens. Perhaps also of relevance, and with some important exceptions, the law does not generally exclude substances extracted from the human body from being the subject of property rights.292 Presumably, the same precepts that stir the law to accept limited notions of ownership in bodily substances also drive courts and policymakers to be open to notions of property in genetic objects.293 A recent strand of scholarship has fruitfully explored whether and how

291. See, e.g., ALASKA STAT. ANN. § 18.13.010(a)(2) (West 2023) (“[A] DNA sample and the results of a DNA analysis performed on the sample are the exclusive property of the person sampled or analyzed.”); COLO. REV. STAT. ANN. § 10-3-1104.7(1)(a) (West 2023) (“Genetic information is the unique property of the individual to whom the information pertains.”); FLA. STAT. ANN. § 760.40(c) (West 2023) (“Except for purposes of criminal prosecution, except for purposes of determining paternity . . . and except for purposes of acquiring specimens . . . the results of such DNA analysis, whether held by a public or private entity, are the exclusive property of the person tested.”); GA. CODE ANN. § 33-54-1(1) (West 2023) (“Genetic information is the unique property of the individual tested.”); Suter, supra note 43, at 744 n.27 (discussing additional state bills and legislation creating property rights in genetic objects); Prince, supra note 41, at 195–98.

292. The law generally allows for the sale and ownership of human bodily substances that are not scarce and thus do not raise the same policy concerns as organs. See, e.g., 42 U.S.C. § 274e(c)(1) (The National Organ Transplant Act (NOTA) narrowly defines human organ so as to exclude human gametes, thereby allowing for the sale of such cells); GA. CODE ANN. § 16-12-160(b)(1) (West 2023) (“The purchase or sale of whole blood, blood plasma, blood products, blood derivatives, other self-replicating body fluids, or hair” is exempted from the prohibition on sale of the human body or any part thereof). Still, virtually every jurisdiction in the United States and Europe makes exceptions to this general rule regarding the ownership of human organs and corpses. See, e.g., TEX. PENAL CODE ANN. § 48.02 (West 2023) (prohibiting the purchase and sale of human organs); WIS. STAT. § 146.345 (West 2023) (prohibiting the sale of human organs for use in transplantation); FLA. STAT. § 873.01 (West 2023) (prohibiting the purchase or sale of human organs and tissue); 42 U.S.C. § 274e(a) (forbidding the acquisition, receipt or any other transfer of human organs outside the context of lawful organ donations); see also, e.g., WILLIAM L. PROSSER, THE LAW OF TORTS 58–59 (4th ed. 1971) (referring to a “property right” to a corpse, which does not exist while the decedent is living and is used for the purpose of burial); Siver v. Rockingham Mem’l Hosp., 48 F. Supp. 2d 608, 610 (W.D. Va. 1999) (noting that Virginia recognizes a quasi-property right to preserve and bury the remains of a human body as well as a right to bring an action in tort for unlawful invasion of a near-relative’s rights with respect to a dead body); Justine Pila, Property in Human Genetic Material: An Old Legal Question for a New Technological Age, in THE OXFORD HANDBOOK OF COMPARATIVE HEALTH LAW 808, 808–39 (David Orentlicher & Tamara K. Hervey eds., 2020) (reviewing and commenting on the status of human body parts and materials under different property laws). See generally Alix Rogers, Unearthing the Origins of Quasi-Property Status, 72 HASTINGS L.J. 291 (2020).

293. To date, relatively few states have enacted genetic property laws. See, e.g., Leslie E. Wolf, Erin C. Fuse Brown, Ryan Kerr, Genevieve Razick, Gregory Tanner, Brett Duvall, Sakinah Jones, Jack Brackney & Tatiana Posad, The Web of Legal Protections for Participants in Genomic Research, 29 HEALTH MATRIX 3, 72 (2019) (only five state statutes hold genetic
existing property doctrines may serve as a model for approaching interests in genetic objects or specific aspects of such objects. Yet, incorporating a broader range of interests in genetic objects—including those stemming from dimensions not amenable to property analysis—into the legal discourse remains challenging.

Where genetic objects do not clearly implicate commercial interests or where the alleged injuries involving the genetic objects are not readily quantifiable, jurists typically tend to gravitate toward privacy law categorizations. Court cases like King and legislative frameworks such as GINA’s illustrate this tendency. However, treating matters involving genetic objects exclusively through the lens of privacy law constructs rather than property law suffers from similar deficiencies. It, too, only allows for a limited group of interests—mostly stemming from the informational and individual-identity-conferring dimensions of genetic objects—within the legal discourse.

The framework we propose offers a way of “breaking the mold” to incorporate the multidimensionality of genetic objects and to consider more malleable legal responses that take broader sets of interests into account. This is not to say that property and privacy doctrines ought to have no future role in the legal treatment of matters involving genetic objects. On the contrary: instead of privileging one dimension or set of characteristics of genetic objects, our framework would allow jurists to grow existing and new legal doctrines to account for, weigh, and
accommodate the multiplicity of dimensions of genetic objects and the richness of stakeholder interests stemming from these dimensions. Jurists have the requisite skill set to identify, invoke, and respond to competing interests in legal decision making. Judges, lawmakers, policymakers, and sometimes even lawyers are adept at balancing, reconciling, and harmonizing seemingly competing interests. It is time jurists conscientiously and intentionally brought these skills to the fore in matters involving genetic phenomena. They should resist approaching such matters exclusively within the confines of longstanding doctrines, many of which developed in contexts that cannot adequately accommodate the variety of genetic dimensions in the law. Rather, they should approach legal questions that implicate genetics in ways that reckon with but also transcend established categorizations to better account for the multidimensionality of the relevant genetic objects.

V. CONCLUSION

This Article has identified and analyzed the impact of the longstanding practice among jurists of applying ill-fitting legal constructs to genetic phenomena. It has demonstrated how this practice causes a disconnect between genetics and the law; a disconnect that can be traced to the failure to account for the multifaceted nature of genetic phenomena and the corresponding range of different interests of various stakeholders.

It has presented case studies drawn from disparate areas of the law to show how existing legal constructs across a variety of legal fields—including property, privacy, tort, IP, criminal and constitutional law—regularly fail to adequately capture the full range of stakeholder interests in genetic phenomena. We have offered in response a novel analytical framework for incorporating the multiple dimensions of genetic phenomena and the interests stemming from these dimensions into legal decision-making. This framework offers legislators, judges, regulators, and lawyers a new way of thinking about genetics in the law that accounts for and accommodates the full range of individual, group, and societal interests in genetic phenomena. With this framework in place, jurists will be better prepared to address the complex questions that arise when legal decision-making implicates genetics.