

THE FEDERAL CIRCUIT’S DECISION IN *MYRIAD*: ISOLATED DNA MOLECULES ARE PATENTABLE SUBJECT MATTER

SETH R. OGDEN*

TABLE OF CONTENTS

Introduction.....	443
I. Background	446
A. The Science of DNA.....	446
B. Facts and Procedural History.....	447
II. Analysis.....	449
A. Section 101 Analyses Should Focus on Differences from Naturally Occurring Compositions Rather Than Similarities	449
B. Differences Between the Chemical Structures of Isolated and Native DNA Molecules Render Isolated DNA Molecules Patentable	452
C. Maintaining Patent Eligibility of Isolated DNA Sequences Comports With Longstanding PTO Practice.....	454
Conclusion	455

INTRODUCTION

The human genome comprises approximately 23,000 protein-coding genes.¹ For over thirty years, the United States Patent and Trademark Office (PTO) has issued patents on isolated

* Senior Staff Member, *American University Law Review*, Volume 61; J.D. Candidate, May 2012, *American University, Washington College of Law*, Ph.D., Cancer Biology, 2009, *Vanderbilt University*; B.A., Biology, 2003, *University of Virginia*; USPTO Registration Number 65,168. Many thanks to the staff of the *American University Law Review* for their efforts in bringing this piece to publication. I would especially like to thank Dr. Richard Peek, Jr. and his laboratory for all they taught me during my pursuit of a Ph.D. and my parents for their continuing support of a “perpetual” student.

1. Int’l Human Genome Sequencing Consortium, *Finishing the Euchromatic Sequence of the Human Genome*, 431 *NATURE* 931, 942 (2004).

deoxyribonucleic acid (DNA) molecules encoding sequences identical to human genes as found in nature.² As a result, approximately 20% of all human genes are patented, some as many as twenty times.³ A number of patents claim isolated DNA molecules encoding mutations that increase a person's risk of developing disease, making them useful tools for genetic testing.⁴ Proponents of gene patenting assert that such patents stimulate investment and research by rewarding scientists with exclusive rights in their invention.⁵ Opponents, on the other hand, argue that gene patents impede access to patient testing, decrease the quality of genetic testing, and create barriers to research.⁶

Though the statutory definition of patentable material⁷ has been

2. *Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office (Myriad)*, 653 F.3d 1329, 1355, 99 U.S.P.Q.2d (BNA) 1398, 1418 (Fed. Cir. 2011).

3. Kyle Jensen & Fiona Murray, *Intellectual Property Landscape of the Human Genome*, 310 SCI. 239, 239 (2005). The subject matter of gene patenting is not the genes themselves, but isolated DNA molecules comprising sequences identical to the sequences of the human gene as found in nature, a composition of matter. *See, e.g., Myriad*, 653 F.3d at 1351, 99 U.S.P.Q.2d (BNA) at 1415 (providing an example of a claimed isolated DNA molecule and describing the relationship between isolated DNA sequences and naturally occurring DNA or genes). As used in this Note, "gene patents" or "gene patenting" refer to the patenting of the isolated DNA molecule, not to the gene sequence itself.

4. *See Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office*, 702 F. Supp. 2d 181, 195, 94 U.S.P.Q.2d (BNA) 1683, 1693 (S.D.N.Y. 2010) (discussing the connection between genetic mutations and the propensity for particular diseases), *aff'd in part, rev'd in part*, 653 F.3d 1329, 99 U.S.P.Q.2d (BNA) 1398 (Fed. Cir. 2011).

5. *See Myriad Defendants' Memorandum of Law (1) in Support of Their Motion for Summary Judgment & (2) in Opposition to Plaintiffs' Motion for Summary Judgment at 46, Ass'n for Molecular Pathology*, 702 F. Supp. 2d 181, 94 U.S.P.Q.2d (BNA) 1683 (No. 09 Civ. 4515), 2009 WL 5785008 at *53 [hereinafter *Myriad's Memo*] (indicating that at least 8600 research papers have been directed toward *Myriad's* claimed gene sequences since their disclosure); SEC'Y'S ADVISORY COMM. ON GENETICS, HEALTH, & SOC'Y, U.S. DEP'T OF HEALTH & HUMAN SERVS., *GENE PATENTS AND LICENSING PRACTICES AND THEIR IMPACT ON PATIENT ACCESS TO GENETIC TESTS 28–29* (2010) [hereinafter *SACGHS REPORT*], available at http://oba.od.nih.gov/oba/SACGHS/reports/SACGHS_patents_report_2010.pdf (summarizing legal and economic scholarship and public comments supporting the view that patents stimulate investment in genetic testing); Lisa A. Haile, *IP Position Critical to Biotech Investment*, WALL STREET BIOBEAT (Apr. 1, 2010), <http://www.genengnews.com/gen-articles/ip-position-critical-to-biotech-investment/3235/> (noting that the strength of a company's intellectual property strategy and position is one of the top three questions posed by investors).

6. *See, e.g., SACGHS REPORT, supra* note 5, at 39–45 (explaining that limited access arises in the context of a sole testing provider because lack of competition inflates prices above what insurance companies will cover); Steve Benowitz, *French Challenge to BRCA1 Patent Underlies European Discontent*, 94 J. NAT'L CANCER INST. 80–81 (2002) (finding that *Myriad's* testing procedure failed to detect ten to twenty percent of mutations); John P. Walsh et al., *View from the Bench: Patents and Materials Transfers*, 309 SCI. 2002, 2002 (2005) (determining that out of 381 academic scientists, none stopped their research due to the existence of patents).

7. 35 U.S.C. § 101 (2006) (providing that a patent is available for new and

broadly construed, the United States Supreme Court has recognized three judicially-created exceptions to patentability: laws of nature, physical phenomena, and abstract ideas.⁸ Recently, the United States District Court for the Southern District of New York determined that claims to isolated DNA molecules cover patent-ineligible products of nature, asserting that as the physical embodiment of biological information, DNA represents the physical embodiment of laws of nature.⁹ In *Ass'n for Molecular Pathology v. United States Patent & Trademark Office (Myriad)*,¹⁰ the United States Court of Appeals for the Federal Circuit reversed the district court's decision, holding that claims to such isolated DNA are patentable subject matter.¹¹ Through scientific analysis, the court reasoned that the chemical and structural differences between isolated DNA molecules and DNA as found in nature were "distinctive," rendering isolated DNA molecules patent-eligible.¹²

This Note examines the *Myriad* decision, analyzing the science behind isolated DNA in light of historical Supreme Court jurisprudence regarding the patentability of inventions derived from nature. Part I examines the science of DNA and sets forth the facts and procedural history of the case. Part II argues that Supreme Court decisions regarding the patentability of inventions derived from nature require an assessment of the differences between the claimed subject matter and that found in nature. Part II further argues that the Federal Circuit correctly found that isolated DNA molecules are patent-eligible under this analysis, and that the *Myriad* decision supports stability within the patent system. This Note concludes that by following the analytical framework set forth in *Myriad*, which emphasizes the differences between an invention and a

useful inventory and discoveries, or new and useful improvements on existing patents).

8. See *Diamond v. Chakrabarty*, 447 U.S. 303, 309, 206 U.S.P.Q. (BNA) 193, 197 (1980) (citing *Parker v. Flook*, 437 U.S. 584, 198 U.S.P.Q. (BNA) 193 (1978); *Gottschalk v. Benson*, 409 U.S. 63, 67, 175 U.S.P.Q. (BNA) 673, 675 (1972); *Funk Bros. Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127, 130, 76 U.S.P.Q. (BNA) 280, 281 (1948); *O'Reilly v. Morse*, 56 U.S. (15 How.) 62, 112–21 (1854); *Le Roy v. Tatham*, 55 U.S. (14 How.) 156, 175 (1853)) (providing examples of such exceptions of a new mineral found in the earth, a new plant found in the wild, Einstein's law that $E=mc^2$, and Newton's law of gravity).

9. See *Ass'n for Molecular Pathology*, 702 F. Supp. 2d at 228, 94 U.S.P.Q.2d (BNA) at 1719 (holding invalid claims to not only isolated DNA molecules comprising sequences identical to those found in nature but also cDNA, which is synthesized from a natural template).

10. 653 F.3d 1329, 99 U.S.P.Q.2d (BNA) 1398 (Fed. Cir. 2011).

11. *Id.* at 1352–54, 99 U.S.P.Q.2d (BNA) at 1416–17.

12. *Id.* at 1350–51, 99 U.S.P.Q.2d (BNA) at 1415.

product of nature, courts will promote scientific progress by avoiding fundamental changes to more than a century of precedent and PTO practice in the field of biotechnology.

I. BACKGROUND

A. *The Science of DNA*

DNA exists in nature as linear sequences of nucleotides (chemical units that include one of four bases: adenine, thymine, guanine, and cytosine) that are packaged into chromosomes.¹³ Each chromosome contains hundreds of genes, occurring one after the other as discrete lengths of sequence within the linear DNA.¹⁴ The order of the nucleotide sequences within a gene determines the function of the protein produced by that gene, and the characteristics of individual proteins collectively contribute to the genetic traits of a person.¹⁵ During transcription, DNA is copied repeatedly into a similar form known as messenger RNA (mRNA).¹⁶ Subsequently, during translation, protein is synthesized according to the mRNA templates.¹⁷ The resulting proteins then interact to perform a host of functions within the cell. A simple analogy illustrates the concept: a person reads instructions (DNA) for how to put a table together, and that person's brain processes the information (transcription) into a signal (mRNA); that signal (mRNA) instructs the body to carry out the processed instructions from the brain to put the table's components (proteins) together (translation).

Importantly, alterations of the nucleotide sequences, called mutations, can occur.¹⁸ Genetic mutations can increase a person's risk of developing a variety of serious diseases, including cancer.¹⁹

13. HARVEY LODISH ET AL., *MOLECULAR CELL BIOLOGY* 8, 101–03 (4th ed. 2001).

14. *Id.* at 4, 8.

15. *See id.* at 5, 100–01 (discussing the central dogma of molecular biology—the sequence of DNA directs the synthesis of RNA, which then directs assembly of proteins).

16. *See id.* at 111–16 (providing an overview of transcription).

17. *See id.* at 116–19, 127 (providing an overview of translation). DNA includes both coding (“exons”) and non-coding (“introns”) lengths of nucleotide sequence. *Id.* at 116. During transcription, introns are excised (“spliced”) from mRNA, leaving only the exons. *Id.* cDNA, synthesized from an mRNA template in the laboratory, contains only the sequence of the exons, an important distinction noted in all three opinions produced by the *Myriad* court. *Id.* at 219.

18. *Id.* at 254.

19. *Id.* at 258–59, 1061; *see also* Marisa Noelle Pins, Note, *Impeding Access to Quality Patient Care and Patient Rights: How Myriad Genetics' Gene Patents Are Unknowingly Killing Cancer Patients and How to Calm the Ripple Effect*, 17 J. INTELL. PROP. L. 377, 384 (2010) (noting that, though some inherited mutations are innocuous, others may

Likewise, specific mutations of *BRCA1/2*,²⁰ the gene at issue in *Myriad*, increase the risk of breast and ovarian cancer.²¹ Because an increased risk for breast or ovarian cancer has implications for an individual's choice of lifestyle and preventative care, the scientific and healthcare communities are intensifying research into genetic testing to facilitate early identification of *BRCA1/2* mutations in patients.²² Current testing relies on the isolated DNA molecules encoding *BRCA1/2* gene sequences claimed by Myriad's patents.²³

B. *Facts and Procedural History*

Myriad Genetics ("Myriad") holds several patents,²⁴ claiming, inter alia, isolated DNA molecules encoding the human *BRCA1/2* genes.²⁵ A representative composition claim reads, "[a]n isolated DNA coding for a BRCA1 polypeptide, said polypeptide having the [following] amino acid sequence."²⁶ Certain mutations of the *BRCA1/2* genes

increase a person's risk for a variety of diseases).

20. *BRCA1* and *BRCA2* stand for "breast cancer 1, early onset," and "breast cancer 2, early onset," respectively. See, e.g., *Homo Sapiens Breast Cancer 2, Early Onset (BRCA2)*, mRNA, NIH NCBI GenBank, http://www.ncbi.nlm.nih.gov/nuccore/NM_000059.3 (last visited Nov. 14, 2011).

21. The average woman in the United States, without such a mutation, has about a 12% chance of developing breast cancer in her lifetime, but carriage of an abnormal *BRCA1* or *BRCA2* gene augments this to about an 80% chance. *Genetics*, BREASTCANCER.ORG, <http://www.breastcancer.org/risk/factors/genetics.jsp> (last modified Feb. 15, 2011). Such mutations also increase a woman's risk for developing ovarian, colon, pancreatic, and thyroid cancers. *Id.*

22. See, e.g., *Study Groups*, CIMBA (THE CONSORTIUM OF INVESTIGATORS OF MODIFIERS OF *BRCA1/2*), <http://www.srl.cam.ac.uk/consortia/cimba/groups/groups.html> (last visited Nov. 2, 2011) (listing fifty-one members worldwide of a scientific consortium for researching *BRCA1/2*).

23. See SACGHS REPORT, *supra* note 5, at 23 (noting that Myriad's patent holdings have made it the sole provider of *BRCA* testing in the United States).

24. Complaint ¶ 31, *Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office*, 702 F. Supp. 2d 181, 94 U.S.P.Q.2d (BNA) 1683 (S.D.N.Y. 2010) (No. 09 Civ. 4515), 2009 WL 1343027 at *14 [hereinafter AMP Complaint]. The challenged patents include U.S. Patent No. 5,747,282 (filed June 7, 1995), U.S. Patent No. 5,837,492 (filed Apr. 29, 1996), U.S. Patent No. 5,693,473 (filed June 7, 1995), U.S. Patent No. 5,709,999 (filed June 7, 1995), U.S. Patent No. 5,710,001 (filed June 7, 1995), U.S. Patent No. 5,753,441 (filed Jan. 5, 1996), and U.S. Patent No. 6,033,857 (filed Mar. 20, 1998). *Id.* ¶ 32(a)–(d).

25. The composition claims are directed toward isolated DNA sequences having identity to both the sequence as it exists in the human body as well as to cDNA sequences. See *Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office (Myriad)*, 653 F.3d 1329, 1349–50, 99 U.S.P.Q.2d (BNA) 1398, 1414 (Fed. Cir. 2011) (including cDNA molecules in holding that isolated DNA molecules are patentable); see also *supra* text accompanying note 17 (describing the difference between native DNA and cDNA). Collectively, the patents also claim methods of analyzing or comparing a patient's *BRCA1/2* sequence with normal or mutated sequences and a method claim directed to a method of screening potential cancer therapeutics. *Myriad*, 653 F.3d at 1334, 99 U.S.P.Q.2d (BNA) at 1402.

26. U.S. Patent No. 5,747,282 col.153 ll.57–58 (filed June 7, 1995).

result in an increased risk of the development of breast and ovarian cancer.²⁷ By securing its intellectual property through these patents, Myriad has established itself as the sole provider of commercial genetic testing related to breast and ovarian cancer linked to the *BRCA1/2* genes.²⁸

On May 12, 2009, the Association for Molecular Pathology (AMP) and nineteen other plaintiffs, including healthcare associations, individual doctors, researchers, and patients, filed a lawsuit against the PTO, Myriad, and ten other individual defendants in their capacity as Directors of the University of Utah Research Foundation challenging the validity of Myriad's gene patents.²⁹ AMP alleged that the patent claims were invalid under 35 U.S.C. § 101 because "human genes are products of nature," and, as such, they do not constitute patentable subject matter.³⁰

On March 29, 2010, the Southern District of New York granted the plaintiffs' motion for summary judgment, holding the patents related to *BRCA1/2* invalid.³¹ The court asserted that, "DNA represents the physical embodiment of biological information, distinct in its essential characteristics from any other chemical found in nature."³² By conveying information defining the construction of the human body, DNA serves as a "physical embodiment of laws of nature."³³ Therefore, the court concluded that the isolated DNA molecules containing sequences found in nature were unpatentable subject matter under 35 U.S.C. § 101.³⁴ Myriad filed a Notice of Appeal to

27. *Myriad*, 653 F.3d at 1338–39, 99 U.S.P.Q.2d (BNA) at 1405.

28. AMP Complaint, *supra* note 24, ¶ 48. Though Myriad regularly enforces its patents against entities providing commercial diagnostic testing, it does not enforce its patents against research activities of academic institutions. *See, e.g.*, *Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office*, 669 F. Supp. 2d 365, 379 (S.D.N.Y. 2009) (referencing a letter to a National Cancer Institute investigator assuring her that Myriad would not interfere with her research activities despite the fact that it had attempted to block the commercial use of *BRCA1/2* by other labs), *aff'd in part, rev'd in part*, 653 F.3d 1329, 99 U.S.P.Q.2d 1398 (Fed. Cir. 2011).

29. AMP Complaint, *supra* note 24, ¶¶ 27–29, 32.

30. *Id.* ¶ 102. The plaintiffs also alleged invalidity under the United States Constitution, specifically under Article I, Section 8, clause 8, the First Amendment, and the Fourteenth Amendment. *Id.* ¶¶ 102–03. The district court ultimately dismissed these claims under the doctrine of constitutional avoidance. *Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office*, 702 F. Supp. 2d 181, 238, 94 U.S.P.Q.2d (BNA) 1683, 1726 (S.D.N.Y. 2010), *aff'd in part, rev'd in part*, 653 F.3d 1329, 99 U.S.P.Q.2d 1398 (Fed. Cir. 2011).

31. *Ass'n for Molecular Pathology*, 702 F. Supp. 2d at 232, 238, 94 U.S.P.Q.2d (BNA) at 1722, 1726.

32. *Id.* at 185, 94 U.S.P.Q.2d (BNA) at 1686.

33. *Id.* at 228, 94 U.S.P.Q.2d (BNA) at 1719.

34. *Id.* at 232, 94 U.S.P.Q.2d (BNA) at 1722. The courts have excluded from patentable subject matter laws of nature, physical phenomena, and abstract ideas. *See*

the Federal Circuit on June 16, 2010,³⁵ which heard oral arguments on April 4, 2011.³⁶

II. ANALYSIS

A. *Section 101 Analyses Should Focus on Differences from Naturally Occurring Compositions Rather Than Similarities*

35 U.S.C. § 101 states that “[w]hoever invents or discovers any new and useful . . . composition of matter . . . may obtain a patent therefor.”³⁷ This section has been broadly construed, including as statutory subject matter “anything under the sun that is made by man.”³⁸ In the same breath, the Supreme Court has recognized three judicially-created exceptions to patentability: laws of nature, physical phenomena, and abstract ideas.³⁹

As previous cases illustrate, not all inventions derived from nature

supra note 8 and accompanying text. Here, the court reasoned that the “essential characteristic” of DNA is its underlying nucleotide sequence. *Ass’n for Molecular Pathology*, 702 F. Supp. 2d at 231–32, 94 U.S.P.Q.2d (BNA) at 1721. Because the claimed invention does not differ from native DNA with regard to the underlying sequence, the court held that the claimed DNA was not patentable subject matter, as it was essentially an embodiment of a law of nature. *Id.* at 232, 94 U.S.P.Q.2d (BNA) at 1722. The court further concluded that the claimed comparisons of DNA involved in the diagnostic methods were simply abstract mental processes, also rendering them unpatentable under 35 U.S.C. § 101. *Id.* at 232–37, 94 U.S.P.Q.2d (BNA) at 1722–25.

35. Myriad Defendants’ Notice of Appeal, *Ass’n for Molecular Pathology*, 702 F. Supp. 2d 181, 94 U.S.P.Q.2d 1683 (No. 09 Civ. 4515).

36. Oral Argument, *Ass’n for Molecular Pathology v. U.S. Patent & Trademark Office (Myriad)*, 653 F.3d 1329, 99 U.S.P.Q.2d (BNA) 1398 (Fed. Cir. 2011) (No. 2010-1406), available at <http://www.cafc.uscourts.gov/oral-argument-recordings/2010-1406/all> (click “2010-1406.mp3” link); see Ryan B. Chirnomas, AMP v. U.S.P.T.O.: *Oral Argument at the Federal Circuit*, PATENT LAW PRACTICE CTR. (Apr. 5, 2011, 12:21 PM), <http://patentlawcenter.pli.edu/2011/04/05/ampvuspto/> (summarizing oral arguments in the *Myriad* case).

37. 35 U.S.C. § 101 (2006) (codification of the amended Patent Act of 1952).

38. *Diamond v. Chakrabarty*, 447 U.S. 303, 309, 206 U.S.P.Q. (BNA) 193, 197 (1980) (quoting S. REP. NO. 82-1979, at 5 (1952); H.R. REP. NO. 82-1923, at 6 (1952)) (internal quotation marks omitted); see also *Bilski v. Kappos*, 130 S. Ct. 3218, 3225, 95 U.S.P.Q.2d (BNA) 1001, 1005 (2010) (noting that the Supreme Court construed § 101 broadly because “Congress plainly contemplated that the patent laws would be given wide scope” (quoting *Chakrabarty*, 447 U.S. at 308, 206 U.S.P.Q. (BNA) at 197) (internal quotation marks omitted)).

39. See *Chakrabarty*, 447 U.S. at 309, 206 U.S.P.Q. (BNA) at 197 (citing *Parker v. Flook*, 437 U.S. 584, 198 U.S.P.Q. (BNA) 193, 195 (1978) (rejecting a patent for a mathematical formula); *Gottschalk v. Benson*, 409 U.S. 63, 67, 175 U.S.P.Q. (BNA) 673, 675 (1972) (rejecting a patent for a mathematical formula); *Funk Bros. Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127, 130, 76 U.S.P.Q. (BNA) 280, 281 (1948) (“For patents cannot issue for the discovery of the phenomena of nature.”); *O’Reilly v. Morse*, 56 U.S. (15 How.) 62, 112–21 (1854) (rejecting a claim to all use of electromagnetism as a motive power); *Le Roy v. Tatham*, 55 U.S. (14 How.) 156, 175 (1853) (proposing that “a principle is not patentable”).

are necessarily excluded from patentability.⁴⁰ Therefore, the Federal Circuit looked to the Supreme Court's decisions in *Funk Bros. Seed Co. v. Kalo Inoculant Co.*⁴¹ and *Diamond v. Chakrabarty*⁴² to frame its decision that isolated DNA molecules are patentable subject matter.⁴³ In *Funk Bros.*, the patent-in-suit claimed a mixture of several nitrogen-fixing bacteria strains that did not mutually inhibit one another, making the mixture capable of inoculating a broader range of leguminous plants than single-species cultures.⁴⁴ The Court held that the mixture was not patentable because no individual species within the mixture acquired a novel use or underwent an enlargement of utility.⁴⁵ In *Chakrabarty*, the Court determined that a bacterium genetically engineered to include four naturally occurring DNA plasmids was patentable subject matter.⁴⁶ It reasoned that the claim was not for a natural phenomenon, but for a composition of matter "having a distinctive name, character [and] use" resulting from human ingenuity.⁴⁷ Distinguishing *Funk Bros.*, the *Chakrabarty* Court

40. See, e.g., *Chakrabarty*, 447 U.S. at 305, 310, 206 U.S.P.Q. (BNA) at 195, 197 (validating a patent for a genetically engineered microorganism); *In re Kubin*, 561 F.3d 1351, 1352, 90 U.S.P.Q.2d (BNA) 1417, 1418 (Fed. Cir. 2009) (invalidating isolated DNA molecules encoding Natural Killer Cell Activation Inducing Ligand only for obviousness and lack of a written description); *Amgen, Inc. v. Chugai Pharm. Co.*, 927 F.2d 1200, 1204, 1219, 18 U.S.P.Q.2d (BNA) 1016, 1019, 1031 (Fed. Cir. 1991) (validating and enforcing a claim of isolated DNA molecules encoding human erythropoietin); *Merck & Co. v. Olin Mathieson Chem. Corp.*, 253 F.2d 156, 157, 164, 116 U.S.P.Q. (BNA) 484, 485, 490 (4th Cir. 1958) (validating a patent on a form of vitamin B₁₂); *Kuehmsted v. Farbenfabriken of Elberfeld Co.*, 179 F. 701, 705 (7th Cir. 1910) (enforcing a patent claiming aspirin); *Union Carbide Co. v. Am. Carbide Co.*, 181 F. 104, 105, 110 (2d Cir. 1910) (enforcing a patent for a form of crystalline calcium carbide); *Parke-Davis & Co. v. H. K. Mulford Co.*, 189 F. 95, 97, 103 (C.C.S.D.N.Y. 1911) (enforcing a patent claiming extracted adrenalin), *aff'd in part, rev'd in part*, 196 F. 496 (2d Cir. 1912); *In re Bergstrom*, 427 F.2d 1394, 1400, 166 U.S.P.Q. (BNA) 256, 261 (C.C.P.A. 1970) (validating a patent for two types of purified prostaglandins); *In re Williams*, 171 F.2d 319, 319-20, 80 U.S.P.Q. (BNA) 150, 150-52 (C.C.P.A. 1948) (upholding a claim of a laevo rotary form of a lactone compound).

41. 333 U.S. 127, 76 U.S.P.Q. (BNA) 280 (1948).

42. 447 U.S. 303, 206 U.S.P.Q. (BNA) 193 (1980).

43. *Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office (Myriad)*, 653 F.3d 1329, 1350, 99 U.S.P.Q.2d (BNA) 1398, 1414 (Fed. Cir. 2011).

44. *Funk Bros.*, 333 U.S. at 129-30, 76 U.S.P.Q. (BNA) at 281.

45. *Id.* at 131, 76 U.S.P.Q. (BNA) at 281-82. Though invalidated by the district court for obviousness, a § 103 determination, the Court cast its decision in terms of § 101, stating that the bacteria's non-inhibition qualities were the work of nature, "like the heat of the sun, electricity, or the qualities of metals." *Id.* at 130, 76 U.S.P.Q. (BNA) at 281.

46. *Chakrabarty*, 447 U.S. at 305 n.1, 310, 206 U.S.P.Q. (BNA) at 195 n.1, 197.

47. *Id.* at 309-10, 206 U.S.P.Q. (BNA) at 197 (quoting *Hartranft v. Wiegmann*, 121 U.S. 609, 615 (1887)) (internal quotation marks omitted); see also S. REP. NO. 71-315, at 6 (1930) (distinguishing a plant discovery resulting from cultivation from the mining of a natural mineral); H.R. REP. NO. 71-1129, at 7 (1930) (same).

noted that, due to Chakrabarty's efforts, the bacterium acquired characteristics markedly different from any bacterium found in nature.⁴⁸

Thus, Supreme Court jurisprudence directs that § 101 analyses turn on a change in a claimed composition's identity compared with what exists in nature.⁴⁹ Rather than examining whether isolated DNA molecules are markedly different from native DNA molecules, however, the Southern District of New York focused on the similarity between the information content of isolated and native DNA molecules' nucleotide sequences.⁵⁰ By focusing on DNA's genetic function of transmitting information, the district court characterized DNA as an unpatentable law of nature, effectively creating a categorical rule excluding all isolated gene sequences from patent eligibility.⁵¹ The district court's failure to take into account differences in chemical structure between the molecules constituted an erroneous comparative analysis.⁵² Because isolated DNA molecules have markedly different chemical structures compared to native DNA molecules, the Federal Circuit rejected the district court's "unwarranted" categorical exclusion of isolated DNA molecules from patentability.⁵³

The Federal Circuit's majority opinion further emphasized that patentability depends on the distinctive chemical and structural nature of isolated DNA molecules rather than their physiological use

48. *Chakrabarty*, 447 U.S. at 310, 206 U.S.P.Q. (BNA) at 197.

49. *Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office (Myriad)*, 653 F.3d 1329, 1351, 99 U.S.P.Q.2d (BNA) 1398, 1415 (Fed. Cir. 2011).

50. *Id.* at 1353, 99 U.S.P.Q.2d (BNA) at 1416. DNA sequences per se are not patentable subject matter. *See Amgen, Inc. v. Chugai Pharm. Co.*, No. 87-2617-Y, 1989 WL 169006, at *32, 13 U.S.P.Q.2d (BNA) 1737, 1759 (D. Mass. Dec. 11, 1989) (stating that a sequence would be a nonpatentable natural phenomenon), *aff'd in part, vacated in part*, 927 F.2d 1200, 1219, 18 U.S.P.Q.2d (BNA) 1016, 1031 (Fed. Cir. 1991).

51. *Myriad*, 653 F.3d at 1353, 99 U.S.P.Q.2d (BNA) at 1416. In recent years, the Supreme Court has tended to disparage the creation of categorical rules in patent jurisprudence. *See Bilski v. Kappos*, 130 S. Ct. 3218, 3227, 95 U.S.P.Q.2d (BNA) 1001, 1007 (2010) (rejecting exclusive application of the machine-or-transformation test for § 101 determinations, which would categorically exclude business methods from patent eligibility); *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 419, 82 U.S.P.Q.2d (BNA) 1385, 1396 (2007) (same regarding use of the teaching, suggestion, or motivation test for § 103 determinations); *Chakrabarty*, 447 U.S. at 314–17, 206 U.S.P.Q. (BNA) at 199–200 (rejecting a categorical rule excluding living organisms from patent eligibility, and instead promoting legislative and executive limitations in this field); *see also Diamond v. Diehr*, 450 U.S. 175, 182, 209 U.S.P.Q. (BNA) 1, 6 (1981) (cautioning courts to avoid reading into the patent laws limitations and conditions not expressed by the legislature).

52. *Myriad*, 653 F.3d at 1353, 1355, 99 U.S.P.Q.2d (BNA) at 1416, 1418.

53. *Id.* at 1353, 99 U.S.P.Q.2d (BNA) at 1417.

or benefit.⁵⁴ Accordingly, the court observed that patent disclosures are better described by the chemical structure of genes, even though biologists' primary consideration may be the function of DNA molecules.⁵⁵ Though such assertions may appear to preclude a utilitarian analysis, precedent requires consideration of whether the intervention of man imparts a new utility that renders the composition markedly different from nature.⁵⁶ In fact, differences in utility may provide guidance as to whether the chemical structure of an isolated composition differs from its structure in nature.⁵⁷

B. Differences Between the Chemical Structures of Isolated and Native DNA Molecules Render Isolated DNA Molecules Patentable

As the Federal Circuit concluded, Myriad's claimed isolated DNA molecules indisputably exist in a chemical form distinctive from native DNA molecules.⁵⁸ In their native forms, genes exist as discrete lengths embedded within a contiguous DNA molecule.⁵⁹ Forty-six such contiguous DNA molecules, in combination with several structural proteins, are packaged into larger complexes called chromosomes.⁶⁰ Isolated DNA molecules, on the other hand, are freestanding portions of a native DNA molecule, chemically cleaved from the chromosomal structure, representing a fraction of the DNA

54. *Id.*, 99 U.S.P.Q.2d (BNA) at 1416.

55. *See id.* at 1353-54, 99 U.S.P.Q.2d (BNA) at 1416-17 (noting that the utility of chemical substances, and therefore isolated DNA sequences, may be relevant to obviousness and patentable subject matter determinations).

56. *See id.* at 1364-65, 99 U.S.P.Q.2d (BNA) at 1425 (Moore, J., concurring in part) (concluding that not only the different chemical structure but also the different and beneficial utility resulting from that chemical structure makes isolated DNA molecules patentable).

57. *See, e.g.*, *Merck & Co. v. Olin Mathieson Chem. Corp.*, 253 F.2d 156, 164, 116 U.S.P.Q. (BNA) 484, 490 (4th Cir. 1958) (upholding patentability of a fermentation-produced vitamin B₁₂ compound having higher activity levels than vitamin B₁₂ produced in the liver because the development resulted in increased therapeutic and commercial worth); *Union Carbide Co. v. Am. Carbide Co.*, 181 F. 104, 107 (2d Cir. 1910) (holding crystalline product patentable where physical properties were better suited for commercial use in gas generators than those of the natural amorphous product); *Kuehmsted v. Farbenfabriken of Elberfeld Co.*, 179 F. 701, 705 (7th Cir. 1910) (upholding a patent for a form of aspirin purified by a process resulting in an increased therapeutic effect compared to aspirin purified by previous methods); *Parke-Davis & Co. v. H. K. Mulford Co.*, 189 F. 95, 103 (C.C.S.D.N.Y. 1911) (holding adrenaline patentable because purification from the adrenal gland transformed it into a new substance commercially and therapeutically), *aff'd in part, rev'd in part*, 196 F. 496 (2d Cir. 1912).

58. *Myriad*, 653 F.3d at 1353, 99 U.S.P.Q.2d (BNA) at 1417.

59. *Id.*, U.S.P.Q.2d (BNA) at 1416; LODISH ET AL., *supra* note 13, at 4, 8.

60. *Myriad*, 653 F.3d at 1352, 99 U.S.P.Q.2d (BNA) at 1415; LODISH ET AL., *supra* note 13, at 8.

molecule as found in nature.⁶¹ For example, *BRCA1*, despite residing on a chromosome containing approximately eighty million nucleotides, comprises only about eighty thousand nucleotides.⁶² Such isolation requires chemical modification through severing of the covalent bonds in the backbone of the larger contiguous DNA molecule, and structural modification by disassociating the DNA molecule from chromosomal structural proteins.⁶³ Thus, the human intervention required to isolate a specific DNA molecule imparts a chemical identity on such isolated DNA molecules distinct from native DNA molecules.⁶⁴ Accordingly, the *BRCA1/2* molecules claimed by Myriad are not the same as *BRCA1/2* molecules as they exist in the body.⁶⁵

In addition, the markedly different chemical structure of isolated DNA compared to that of native DNA is critically important to the isolated DNA molecule's utility.⁶⁶ Isolation allows scientists to focus on the sequence of interest by removing potentially confounding sequences naturally present in the larger chromosomal DNA.⁶⁷ Isolation also renders DNA molecules useful as physical probes and primers to identify genetic mutations.⁶⁸ Native DNA molecules simply

61. *Myriad*, 653 F.3d at 1352, 99 U.S.P.Q.2d (BNA) at 1415.

62. *Id.*, 99 U.S.P.Q.2d (BNA) at 1415 (further explaining that *BRCA1* cDNA, with the exclusion of introns, consists of approximately 5500 nucleotides). Some of Myriad's claims cover isolated DNAs having as few as fifteen nucleotides of a *BRCA* sequence. U.S. Patent No. 5,747,282 col.153, ll.66-67, col.154, ll.56-57 (filed June 7, 1995) (claims five and six).

63. *Myriad*, 653 F.3d at 1352, 99 U.S.P.Q.2d (BNA) at 1415. A covalent bond defines the boundary between one molecule and another, in this case separating one chemical species from another. *Id.* at 1353, 99 U.S.P.Q.2d (BNA) at 1416. Such disassociation can be likened to the purification of prostaglandins in *In re Bergstrom*. 427 F.2d 1394, 1401 & n.10, 166 U.S.P.Q. (BNA) 256, 261-62 & n.10 (C.C.P.A. 1970) (noting that purified prostaglandins were not naturally occurring because they were not found in nature in their pure form, separate from all heterogeneous or extraneous matter).

64. *Myriad*, 653 F.3d at 1353, 99 U.S.P.Q.2d (BNA) at 1416. Isolation of a DNA molecule changes its size, inter alia, thereby altering its chemical identity. Similarly, in *Diamond v. Chakrabarty*, the addition of DNA to a microorganism resulted in a change in the microorganism's chemical identity. 447 U.S. 303, 309-10, 206 U.S.P.Q. (BNA) 193, 197 (1980).

65. *Myriad*, 653 F.3d at 1352, 99 U.S.P.Q.2d (BNA) at 1415.

66. Myriad's Memo, *supra* note 5, at 31.

67. See *Myriad*, 653 F.3d at 1365, 99 U.S.P.Q.2d (BNA) at 1424 (Moore, J., concurring in part) (describing isolated DNA molecules as truncations); see also *Kuehmsted v. Farbenfabriken of Elberfeld Co.*, 179 F. 701, 704-05 (7th Cir. 1910) (emphasizing the claimed aspirin's increased therapeutic effect compared to aspirins purified by previous methods); *Parke-Davis & Co. v. H. K. Mulford Co.*, 189 F. 95, 103 (C.C.S.D.N.Y. 1911) (highlighting the therapeutic utility gained by purifying insulin from surrounding glandular tissue), *aff'd in part, rev'd in part*, 196 F. 496 (2d Cir. 1912).

68. *Myriad*, 653 F.3d at 1365, 99 U.S.P.Q.2d (BNA) at 1425 (Moore, J.,

do not have the chemical and structural properties needed to perform such functions.⁶⁹ Therefore, isolated DNA molecules' usefulness in diagnostic genetic testing constitutes an expansion of their range of utility as compared to native DNA molecules.⁷⁰

C. *Maintaining Patent Eligibility of Isolated DNA Sequences Comports With Longstanding PTO Practice*

Since 2001, PTO policy has explicitly allowed patenting of isolated DNA molecules with the same sequence as naturally occurring genes, reasoning that DNA molecules do not exist in isolated form in nature.⁷¹ Prior to promulgating the current guidelines, the PTO began granting patents for human genes in the 1980s, issuing at least 2600 patents claiming isolated DNA over the past twenty-nine years.⁷² In the three decades that patents have been issued for isolated DNA molecules, Congress has refrained from intervening to exclude those inventions from the broad scope of § 101.⁷³ The biotechnology

concurring in part); Myriad's Memo, *supra* note 5, at 32; *see, e.g.*, U.S. Patent No. 5,693,473 (filed June 7, 1995) (disclosing the use of isolated DNA molecules encoding *BRCA1* as probes for screening patients to determine if they carry specific *BRCA1* mutations resulting in a predisposition for developing cancer); *see also* USPTO Utility Examination Guidelines, 66 Fed. Reg. 1092, 1094 (Jan. 5, 2001) (asserting that an isolated DNA molecule meets the statutory utility requirement if it hybridizes near and serves as a marker for a disease gene).

69. *Myriad*, 653 F.3d at 1365, 99 U.S.P.Q.2d (BNA) at 1425 (Moore, J., concurring in part); Myriad's Memo, *supra* note 5, at 9; *see also* Ass'n for Molecular Pathology v. U.S. Patent & Trademark Office, 702 F. Supp. 2d 181, 196, 94 U.S.P.Q.2d (BNA) 1683, 1694-95 (S.D.N.Y. 2010) (acknowledging that isolated DNA can be used as a tool for biotechnological applications for which native DNA cannot be used), *aff'd in part, rev'd in part*, 653 F.3d 1329, 99 U.S.P.Q.2d 1398 (Fed. Cir. 2011).

70. *Myriad*, 653 F.3d at 1365, 99 U.S.P.Q.2d (BNA) at 1425 (Moore, J., concurring in part) (quoting *Funk Bros. Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127, 131, 76 U.S.P.Q. (BNA) 280, 282 (1948)). Judge Moore continued that because diagnostic testing "is not a natural utility," the claimed DNA does not "serve the ends nature originally provided." *Id.* (quoting *Funk Bros.*, 333 U.S. at 131, 76 U.S.P.Q. (BNA) at 282) (internal quotation marks omitted). In *Funk Bros.*, the Court, though acknowledging the advantage in combining six non-inhibiting strains of inoculating bacteria, emphasized that the combination "produce[d] no new bacteria, no change in the six species of bacteria, and no enlargement of the range of their utility." 333 U.S. at 131, 76 U.S.P.Q. (BNA) at 282. Thus, the combination, independent of any effort of the patentee, "serve[d] the ends nature originally provided." *Id.*, 76 U.S.P.Q. (BNA) at 282.

71. *See* USPTO Utility Examination Guidelines, 66 Fed. Reg. at 1093 (stating that an inventor's discovery of a gene can be the basis for a patent on the isolated and purified genetic composition as separated from other molecules with which it is associated in nature).

72. *Myriad*, 653 F.3d at 1355, 99 U.S.P.Q.2d (BNA) at 1418.

73. *Id.*, 99 U.S.P.Q.2d (BNA) at 1418; 149 CONG. REC. 18,999 (2003) (acknowledging that many institutions have extensive patents on human genes but declining to implement legislation affecting any of those current existing patents).

industry's substantial investments of time and money to secure property rights related to DNA sequences reflect the patent system's ability to spur scientific progress.⁷⁴ Consequently, the Supreme Court has cautioned lower courts against adopting changes with potential to disrupt the settled expectations of the inventing community.⁷⁵ Moreover, because the judiciary is ill-suited to determine whether claims to isolated DNA molecules promote or inhibit "[s]cience and useful [a]rts"⁷⁶ in all but the clearest cases, any change should come from Congress.⁷⁷

CONCLUSION

As biotechnology research intensifies, invention and discovery will blur the line between that which is man-made and that which is naturally occurring. Where a new and useful discovery cannot be reproduced by nature without the aid of man, it deserves patentability, despite any striking similarities to a product of nature. The *Myriad* decision, emphasizing the historical framework to be used in § 101 analyses, underscores the need to examine the differences in identity between an inventive composition and a product of nature.⁷⁸ When scrutinizing composition claims, district courts should take care to focus their § 101 analyses on differences in chemical structure, while keeping in mind that novel utility may be

74. *Myriad*, 653 F.3d at 1368, 99 U.S.P.Q.2d (BNA) at 1427 (Moore, J., concurring in part); see David E. Adelman & Kathryn L. DeAngelis, *Patent Metrics: The Mismeasure of Innovation in the Biotech Patent Debate*, 85 TEX. L. REV. 1677, 1681 (2007) (noting that empirical studies indicate that growth in the number of biotechnology patents issued has not impaired biotech innovation).

75. See *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, 535 U.S. 722, 739, 62 U.S.P.Q.2d (BNA) 1705, 1713 (2002) (advocating following precedent upon application of prosecution history estoppel so as to avoid destroying legitimate expectations of inventors in their property); *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 32 n.6, 41 U.S.P.Q.2d (BNA) 1865, 1872 n.6 (1997) (indicating that such changes have the potential to subvert the balances the PTO sought to strike when issuing numerous patents that have not yet expired and would be affected by such a decision).

76. U.S. CONST. art. I, § 8, cl. 8.

77. *Myriad*, 653 F.3d at 1371, 99 U.S.P.Q.2d (BNA) at 1430 (Moore, J., concurring in part) (suggesting that Congress's constitutional authority and institutional ability are needed to fully accommodate "the varied permutations of competing interests that are inevitably implicated by . . . new technology" (quoting *Sony Corp. of Am. v. Universal City Studios, Inc.*, 464 U.S. 417, 431, 220 U.S.P.Q. (BNA) 665, 674 (1984))); see, e.g., *Diamond v. Chakrabarty*, 447 U.S. 303, 318, 206 U.S.P.Q. (BNA) 193, 201 (1980) (concluding that, until Congress takes action, the court must take the language of § 101 as it is); *Gottschalk v. Benson*, 409 U.S. 63, 72–73, 175 U.S.P.Q. (BNA) 673, 676–77 (1972) (urging that a change in § 101 requires the broad powers of investigation that Congress progresses).

78. See *supra* Part II.A (emphasizing that § 101 analysis should be focused on a claimed composition's identity compared to what exists in nature).

indicative of those differences.⁷⁹ Accordingly, the marked differences in chemical structure and expanded range of utility of isolated DNA molecules when compared to native DNA molecules places them squarely within § 101 patentable subject matter.⁸⁰ The Federal Circuit's approach serves to promote scientific progress by leaving intact the settled expectations of the inventing community fostered by the broad language of § 101, judicial precedent, and the PTO's longstanding policy and practice.⁸¹

79. *See id.* (explaining that the *Myriad* majority determined that DNA chemical structure, rather than function, be the focus of patentability).

80. *See supra* Part II.B (describing the use of isolated genes as probes and primers for identification of genetic mutations as important to their utility over natural DNA).

81. *See supra* Part II.C (promoting only congressional alterations to patentability and following patentability precedent by the PTO).