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MAYO COLLABORATIVE SERVICES, DBA MAYO MEDICAL LABORATORIES, ET AL. *v.* PROMETHEUS LABORATORIES, INC.

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

No. 10–1150. Argued December 7, 2011—Decided March 20, 2012

Although "laws of nature, natural phenomena, and abstract ideas" are not patentable subject matter under § 101 of the Patent Act, *Diamond* v. *Diehr*, 450 U. S. 175, 185, "an *application* of a law of nature . . . to a known structure or process may [deserve] patent protection," *id.*, at 187. But to transform an unpatentable law of nature into a patent-eligible application of such a law, a patent must do more than simply state the law of nature while adding the words "apply it." See, *e. g.*, *Gottschalk* v. *Benson*, 409 U. S. 63, 71–72. It must limit its reach to a particular, inventive application of the law.

Respondent, Prometheus Laboratories, Inc. (Prometheus), is the sole and exclusive licensee of the two patents at issue, which concern the use of thiopurine drugs to treat autoimmune diseases. When ingested, the body metabolizes the drugs, producing metabolites in the bloodstream. Because patients metabolize these drugs differently, doctors have found it difficult to determine whether a particular patient's dose is too high, risking harmful side effects, or too low, and so likely ineffective. The patent claims here set forth processes embodying researchers' findings that identify correlations between metabolite levels and likely harm or ineffectiveness with precision. Each claim recites (1) an "administering" step—instructing a doctor to administer the drug to his patient—(2) a "determining" step—telling the doctor to measure the resulting metabolite levels in the patient's blood—and (3) a "wherein" step—describing the metabolite concentrations above which there is a likelihood of harmful side effects and below which it is likely that the drug dosage is ineffective, and informing the doctor that metabolite concentrations above or below these thresholds "indicate a need" to decrease or increase (respectively) the drug dosage.

Petitioners Mayo Collaborative Services and Mayo Clinic Rochester (Mayo) bought and used diagnostic tests based on Prometheus' patents. But in 2004 Mayo announced that it intended to sell and market its own, somewhat different, diagnostic test. Prometheus sued Mayo contending that Mayo's test infringed its patents. The District Court found that the test infringed the patents but granted summary judgment to

Mayo, reasoning that the processes claimed by the patents effectively claim natural laws or natural phenomena—namely, the correlations between thiopurine metabolite levels and the toxicity and efficacy of thiopurine drugs—and therefore are not patentable. The Federal Circuit reversed, finding the processes to be patent eligible under the Circuit's "machine-or-transformation test." On remand from this Court for reconsideration in light of *Bilski* v. *Kappos*, 561 U. S. 593, which clarified that the "machine-or-transformation test" is not a definitive test of patent eligibility, *id.*, at 603–604, the Federal Circuit reaffirmed its earlier conclusion.

Held: Prometheus' process is not patent eligible. Pp. 77–92.

(a) Because the laws of nature recited by Prometheus' patent claims—the relationships between concentrations of certain metabolites in the blood and the likelihood that a thiopurine drug dosage will prove ineffective or cause harm—are not themselves patentable, the claimed processes are not patentable unless they have additional features that provide practical assurance that the processes are genuine applications of those laws rather than drafting efforts designed to monopolize the correlations. The three additional steps in the claimed processes here are not themselves natural laws but neither are they sufficient to transform the nature of the claims. The "administering" step simply identifies a group of people who will be interested in the correlations, namely, doctors who used thiopurine drugs to treat patients suffering from autoimmune disorders. Doctors had been using these drugs for this purpose long before these patents existed. And a "prohibition against patenting abstract ideas 'cannot be circumvented by attempting to limit the use of the formula to a particular technological environment.'" *Bilski*, *supra*, at 610–611. The "wherein" clauses simply tell a doctor about the relevant natural laws, adding, at most, a suggestion that they should consider the test results when making their treatment decisions. The "determining" step tells a doctor to measure patients' metabolite levels, through whatever process the doctor wishes to use. Because methods for making such determinations were well known in the art, this step simply tells doctors to engage in well-understood, routine, conventional activity previously engaged in by scientists in the field. Such activity is normally not sufficient to transform an unpatentable law of nature into a patent-eligible application of such a law. *Parker* v. *Flook*, 437 U. S. 584, 590. Finally, considering the three steps as an ordered combination adds nothing to the laws of nature that is not already present when the steps are considered separately. Pp. 77–80.

(b) A more detailed consideration of the controlling precedents reinforces this conclusion. Pp. 80–87.

(1) *Diehr* and *Flook*, the cases most directly on point, both addressed processes using mathematical formulas that, like laws of nature, are not themselves patentable. In *Diehr* the overall process was patent eligible because of the way the additional steps of the process integrated the equation into the process as a whole. 450 U. S., at 187. These additional steps transformed the process into an inventive application of the formula. But in *Flook* the additional steps of the process did not limit the claim to a particular application, and the particular chemical processes at issue were all "well known," to the point where, putting the formula to the side, there was no "inventive concept" in the claimed application of the formula. 437 U. S., at 594. Here, the claim presents a case for patentability that is weaker than *Diehr*'s patent-eligible claim and no stronger than *Flook*'s unpatentable one. The three steps add nothing specific to the laws of nature other than what is well-understood, routine, conventional activity, previously engaged in by those in the field. Pp. 80–82.

(2) Further support for the view that simply appending conventional steps, specified at a high level of generality, to laws of nature, natural phenomena, and abstract ideas cannot make those laws, phenomena, and ideas patentable is provided in *O'Reilly* v. *Morse*, 15 How. 62, 114–115; *Neilson* v. *Harford*, Webster's Patent Cases 295, 371; *Bilski*, *supra*, at 611, 612; and *Benson*, *supra*, at 64, 65, 67. Pp. 82–85.

(3) This Court has repeatedly emphasized a concern that patent law not inhibit future discovery by improperly tying up the use of laws of nature and the like. See, *e. g.*, *Benson*, 409 U. S., at 67, 68. Rewarding with patents those who discover laws of nature might encourage their discovery. But because those laws and principles are "the basic tools of scientific and technological work," *id.*, at 67, there is a danger that granting patents that tie up their use will inhibit future innovation, a danger that becomes acute when a patented process is no more than a general instruction to "apply the natural law," or otherwise forecloses more future invention than the underlying discovery could reasonably justify. The patent claims at issue implicate this concern. In telling a doctor to measure metabolite levels and to consider the resulting measurements in light of the correlations they describe, they tie up his subsequent treatment decision regardless of whether he changes his dosage in the light of the inference he draws using the correlations. And they threaten to inhibit the development of more refined treatment recommendations that combine Prometheus' correlations with later discoveries. This reinforces the conclusion that the processes at issue are not patent eligible, while eliminating any temptation to depart from case law precedent. Pp. 85–87.

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(c) Additional arguments supporting Prometheus' position—that the process is patent eligible because it passes the "machine-or-transformation test"; that, because the particular laws of nature that the claims embody are narrow and specific, the patents should be upheld; that the Court should not invalidate these patents under § 101 because the Patent Act's other validity requirements will screen out overly broad patents; and that a principle of law denying patent coverage here will discourage investment in discoveries of new diagnostic laws of nature—do not lead to a different conclusion. Pp. 87–92.

628 F. 3d 1347, reversed.

BREYER, J., delivered the opinion for a unanimous Court.

Stephen M. Shapiro argued the cause for petitioners. With him on the briefs were *Timothy S. Bishop*, *Jeffrey W. Sarles*, *Charles Rothfeld*, *Jonathan Singer*, *John Dragseth*, *Deanna Reichel*, and *Eugene Volokh*.

Solicitor General Verrilli argued the cause for the United States as *amicus curiae*. With him on the brief were *Assistant Attorney General West*, *Deputy Solicitor General Stewart*, *Mark R. Freeman*, *Scott R. McIntosh*, *Kelsi Brown Corkran*, *Raymond T. Chen*, *Thomas W. Krause*, and *Scott C. Weidenfeller*.

Richard P. Bress argued the cause for respondent. With him on the brief were *J. Scott Ballenger*, *Maximilian A. Grant*, *Matthew J. Moore*, and *Gabriel K. Bell*.*

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Briefs of *amici curiae* urging affirmance were filed for the American Intellectual Property Law Association by *Denise W. DeFranco*, *David S. Forman*, and *William G. Barber;* for the Association of University Technology Managers by *Donald R. Ware* and *Barbara A. Fiacco;* for the Biotechnology Industry Organization by *Jeffrey P. Kushan* and *Eric A. Shumsky;* for Genomic Health, Inc., et al. by *Edward R. Reines;* for the

JUSTICE BREYER delivered the opinion of the Court.

Section 101 of the Patent Act defines patentable subject matter. It says:

> "Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title." 35 U. S. C. § 101.

The Court has long held that this provision contains an important implicit exception. "[L]aws of nature, natural phenomena, and abstract ideas" are not patentable. *Diamond* v. *Diehr*, 450 U. S. 175, 185 (1981); see also *Bilski* v. *Kappos*, 561 U. S. 593, 601 (2010); *Diamond* v. *Chakrabarty*, 447 U. S.

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Briefs of *amici curiae* were filed for the Association Internationale pour la Protection de la Propriété Intellectuelle et al. by *Peter C. Schechter* and *Richard P. Beem;* for CONNECT et al. by *Douglas E. Olson*, *Ned Israelsen*, and *Timothy N. Tardibono;* for Health Law, Policy, and Ethics Scholars by *Mark S. Davies* and *Michael K. Gottlieb;* for Microsoft Corp. et al. by *Matthew D. McGill* and *William G. Jenks;* for the New York Intellectual Property Law Association by *Ronald M. Daignault*, *Matthew B. McFarlane*, *Anthony F. LoCicero*, and *Charles R. Macedo;* for Nine Law Professors by *Joshua D. Sarnoff;* for Roche Molecular Systems, Inc., et al. by *Seth P. Waxman*, *Mark C. Fleming*, *Kevin A. Marks*, *Blair Elizabeth Taylor*, *Jeffrey A. Lamken*, and *Sonali S. Srivastava;* and for Verizon Communications, Inc., et al. by *Michael K. Kellogg*, *John Thorne*, and *Paul H. Roeder.*

303, 309 (1980); *Le Roy* v. *Tatham*, 14 How. 156, 175 (1853); *O'Reilly* v. *Morse*, 15 How. 62, 112–120 (1854); cf. *Neilson* v. *Harford*, Webster's Patent Cases 295, 371 (1841) (English case discussing same). Thus, the Court has written that "a new mineral discovered in the earth or a new plant found in the wild is not patentable subject matter. Likewise, Einstein could not patent his celebrated law that $E=mc^2$; nor could Newton have patented the law of gravity. Such discoveries are 'manifestations of . . . nature, free to all men and reserved exclusively to none.'" *Chakrabarty*, *supra*, at 309 (quoting *Funk Brothers Seed Co.* v. *Kalo Inoculant Co.*, 333 U. S. 127, 130 (1948)).

"Phenomena of nature, though just discovered, mental processes, and abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work." *Gottschalk* v. *Benson*, 409 U. S. 63, 67 (1972). And monopolization of those tools through the grant of a patent might tend to impede innovation more than it would tend to promote it.

The Court has recognized, however, that too broad an interpretation of this exclusionary principle could eviscerate patent law. For all inventions at some level embody, use, reflect, rest upon, or apply laws of nature, natural phenomena, or abstract ideas. Thus, in *Diehr* the Court pointed out that "'a process is not unpatentable simply because it contains a law of nature or a mathematical algorithm.'" 450 U. S., at 187 (quoting *Parker* v. *Flook*, 437 U. S. 584, 590 (1978)). It added that "an *application* of a law of nature or mathematical formula to a known structure or process may well be deserving of patent protection." *Diehr*, *supra*, at 187. And it emphasized Justice Stone's similar observation in *Mackay Radio & Telegraph Co.* v. *Radio Corp. of America*, 306 U. S. 86 (1939):

> "'While a scientific truth, or the mathematical expression of it, is not a patentable invention, a novel and useful structure created with the aid of knowledge of scien-

> tific truth may be.'" 450 U. S., at 188 (quoting *Mackay Radio*, *supra*, at 94).

See also *Funk Brothers*, *supra*, at 130 ("If there is to be invention from [a discovery of a law of nature], it must come from the application of the law of nature to a new and useful end").

Still, as the Court has also made clear, to transform an unpatentable law of nature into a patent-eligible *application* of such a law, one must do more than simply state the law of nature while adding the words "apply it." See, *e. g.*, *Benson*, *supra*, at 71–72.

The case before us lies at the intersection of these basic principles. It concerns patent claims covering processes that help doctors who use thiopurine drugs to treat patients with autoimmune diseases determine whether a given dosage level is too low or too high. The claims purport to apply natural laws describing the relationships between the concentration in the blood of certain thiopurine metabolites and the likelihood that the drug dosage will be ineffective or induce harmful side effects. We must determine whether the claimed processes have transformed these unpatentable natural laws into patent-eligible applications of those laws. We conclude that they have not done so and that therefore the processes are not patentable.

Our conclusion rests upon an examination of the particular claims before us in light of the Court's precedents. Those cases warn us against interpreting patent statutes in ways that make patent eligibility "depend simply on the draftsman's art" without reference to the "principles underlying the prohibition against patents for [natural laws]." *Flook*, *supra*, at 593. They warn us against upholding patents that claim processes that too broadly pre-empt the use of a natural law. *Morse*, *supra*, at 112–120; *Benson*, *supra*, at 71–72. And they insist that a process that focuses upon the use of a natural law also contain other elements or a combination of elements, sometimes referred to as an "inventive concept,"

sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the natural law itself. *Flook*, *supra*, at 594; see also *Bilski*, 561 U. S., at 610–611 ("[T]he prohibition against patenting abstract ideas 'cannot be circumvented by attempting to limit the use of the formula to a particular technological environment' or adding 'insignificant postsolution activity' " (quoting *Diehr*, *supra*, at 191–192)).

We find that the process claims at issue here do not satisfy these conditions. In particular, the steps in the claimed processes (apart from the natural laws themselves) involve well-understood, routine, conventional activity previously engaged in by researchers in the field. At the same time, upholding the patents would risk disproportionately tying up the use of the underlying natural laws, inhibiting their use in the making of further discoveries.

I

A

The patents before us concern the use of thiopurine drugs in the treatment of autoimmune diseases, such as Crohn's disease and ulcerative colitis. When a patient ingests a thiopurine compound, his body metabolizes the drug, causing metabolites to form in his bloodstream. Because the way in which people metabolize thiopurine compounds varies, the same dose of a thiopurine drug affects different people differently, and it has been difficult for doctors to determine whether for a particular patient a given dose is too high, risking harmful side effects, or too low, and so likely ineffective.

At the time the discoveries embodied in the patents were made, scientists already understood that the levels in a patient's blood of certain metabolites, including, in particular, 6-thioguanine and its nucleotides (6–TG) and 6-methyl-mercaptopurine (6–MMP), were correlated with the likelihood that a particular dosage of a thiopurine drug

could cause harm or prove ineffective. See U. S. Patent No. 6,355,623, col. 8, ll. 37–40, 2 App. 10 ("Previous studies suggested that measurement of [6-mercaptopurine (6–MP)] metabolite levels can be used to predict clinical efficacy and tolerance to azathioprine or 6–MP" (citing Cuffari, Théorêt, Latour, & Seidman, 6-Mercaptopurine Metabolism in Crohn's Disease: Correlation With Efficacy and Toxicity, 39 Gut 401 (1996))). But those in the field did not know the precise correlations between metabolite levels and likely harm or ineffectiveness. The patent claims at issue here set forth processes embodying researchers' findings that identified these correlations with some precision.

More specifically, the patents—U. S. Patent No. 6,355,623 ('623 patent) and U. S. Patent No. 6,680,302 ('302 patent)—embody findings that concentrations in a patient's blood of 6–TG or of 6–MMP metabolite beyond a certain level (400 and 7,000 picomoles (pmol) per 8×10^8 red blood cells, respectively) indicate that the dosage is likely too high for the patient, while concentrations in the blood of 6–TG metabolite lower than a certain level (about 230 pmol per 8×10^8 red blood cells) indicate that the dosage is likely too low to be effective.

The patent claims seek to embody this research in a set of processes. Like the Federal Circuit we take as typical claim 1 of the '623 patent, which describes one of the claimed processes as follows:

> "A method of optimizing therapeutic efficacy for treatment of an immune-mediated gastrointestinal disorder, comprising:
>
> "(a) administering a drug providing 6-thioguanine to a subject having said immune-mediated gastrointestinal disorder; and
>
> "(b) determining the level of 6-thioguanine in said subject having said immune-mediated gastrointestinal disorder,

> "wherein the level of 6-thioguanine less than about 230 pmol per 8×10^8 red blood cells indicates a need to increase the amount of said drug subsequently administered to said subject and
>
> "wherein the level of 6-thioguanine greater than about 400 pmol per 8×10^8 red blood cells indicates a need to decrease the amount of said drug subsequently administered to said subject." '623 patent, col. 20, ll. 10–25, 2 App. 16.

For present purposes we may assume that the other claims in the patents do not differ significantly from claim 1.

B

Respondent, Prometheus Laboratories, Inc. (Prometheus), is the sole and exclusive licensee of the '623 and '302 patents. It sells diagnostic tests that embody the processes the patents describe. For some time petitioners, Mayo Clinic Rochester and Mayo Collaborative Services (collectively Mayo), bought and used those tests. But in 2004 Mayo announced that it intended to begin using and selling its own test—a test using somewhat higher metabolite levels to determine toxicity (450 pmol per 8×10^8 for 6–TG and 5,700 pmol per 8×10^8 for 6–MMP). Prometheus then brought this action claiming patent infringement.

The District Court found that Mayo's test infringed claim 7 of the '623 patent. App. to Pet. for Cert. 110a–115a. In interpreting the claim, the court accepted Prometheus' view that the toxicity-risk-level numbers in Mayo's test and the claim were too similar to render the tests significantly different. The number Mayo used (450) was too close to the number the claim used (400) to matter given appropriate margins of error. *Id.*, at 98a–107a. The District Court also accepted Prometheus' view that a doctor using Mayo's test could violate the patent even if he did not actually alter his treatment decision in the light of the test. In doing so, the court construed the claim's language, "indicates a need to

decrease" (or "to increase"), as not limited to instances in which the doctor actually decreases (or increases) the dosage level where the test results suggest that such an adjustment is advisable. *Id.*, at 107a–109a; see also Brief for Respondent i (describing claimed processes as methods "for improving . . . treatment . . . by using individualized metabolite measurements *to inform* the calibration of . . . dosages of . . . thiopurines" (emphasis added)).

Nonetheless the District Court ultimately granted summary judgment in Mayo's favor. The court reasoned that the patents effectively claim natural laws or natural phenomena—namely, the correlations between thiopurine metabolite levels and the toxicity and efficacy of thiopurine drug dosages—and so are not patentable. App. to Pet. for Cert. 50a–83a.

On appeal, the Federal Circuit reversed. It pointed out that in addition to these natural correlations, the claimed processes specify the steps of (1) "administering a [thiopurine] drug" to a patient and (2) "determining the [resulting metabolite] level." These steps, it explained, involve the transformation of the human body or of blood taken from the body. Thus, the patents satisfied the Circuit's "machine or transformation test," which the court thought sufficient to "confine the patent monopoly within rather definite bounds," thereby bringing the claims into compliance with § 101. *Prometheus Labs., Inc.* v. *Mayo Collaborative Services*, 581 F. 3d 1336, 1345, 1346–1347 (2009) (internal quotation marks omitted).

Mayo filed a petition for certiorari. We granted the petition, vacated the judgment, and remanded the case for reconsideration in light of *Bilski*, 561 U. S. 593, which clarified that the "machine-or-transformation test" is not a definitive test of patent eligibility, but only an important and useful clue, *id.*, at 603–604. On remand the Federal Circuit reaffirmed its earlier conclusion. It thought that the "machine-

or-transformation test," understood merely as an important and useful clue, nonetheless led to the "clear and compelling conclusion . . . that the . . . claims . . . do not encompass laws of nature or preempt natural correlations." 628 F. 3d 1347, 1355 (2010). Mayo again filed a petition for certiorari, which we granted.

II

Prometheus' patents set forth laws of nature—namely, relationships between concentrations of certain metabolites in the blood and the likelihood that a dosage of a thiopurine drug will prove ineffective or cause harm. Claim 1, for example, states that *if* the levels of 6–TG in the blood (of a patient who has taken a dose of a thiopurine drug) exceed about 400 pmol per $8{\times}10^8$ red blood cells, *then* the administered dose is likely to produce toxic side effects. While it takes a human action (the administration of a thiopurine drug) to trigger a manifestation of this relation in a particular person, the relation itself exists in principle apart from any human action. The relation is a consequence of the ways in which thiopurine compounds are metabolized by the body—entirely natural processes. And so a patent that simply describes that relation sets forth a natural law.

The question before us is whether the claims do significantly more than simply describe these natural relations. To put the matter more precisely, do the patent claims add *enough* to their statements of the correlations to allow the processes they describe to qualify as patent-eligible processes that *apply* natural laws? We believe that the answer to this question is no.

A

If a law of nature is not patentable, then neither is a process reciting a law of nature, unless that process has additional features that provide practical assurance that the process is more than a drafting effort designed to monopolize the law of nature itself. A patent, for example, could not

simply recite a law of nature and then add the instruction "apply the law." Einstein, we assume, could not have patented his famous law by claiming a process consisting of simply telling linear accelerator operators to refer to the law to determine how much energy an amount of mass has produced (or vice versa). Nor could Archimedes have secured a patent for his famous principle of flotation by claiming a process consisting of simply telling boat builders to refer to that principle in order to determine whether an object will float.

What else is there in the claims before us? The process that each claim recites tells doctors interested in the subject about the correlations that the researchers discovered. In doing so, it recites an "administering" step, a "determining" step, and a "wherein" step. These additional steps are not themselves natural laws but neither are they sufficient to transform the nature of the claim.

First, the "administering" step simply refers to the relevant audience, namely, doctors who treat patients with certain diseases with thiopurine drugs. That audience is a preexisting audience; doctors used thiopurine drugs to treat patients suffering from autoimmune disorders long before anyone asserted these claims. In any event, the "prohibition against patenting abstract ideas 'cannot be circumvented by attempting to limit the use of the formula to a particular technological environment.'" *Bilski*, *supra*, at 610–611 (quoting *Diehr*, 450 U. S., at 191–192).

Second, the "wherein" clauses simply tell a doctor about the relevant natural laws, at most adding a suggestion that he should take those laws into account when treating his patient. That is to say, these clauses tell the relevant audience about the laws while trusting them to use those laws appropriately where they are relevant to their decisionmaking (rather like Einstein telling linear accelerator operators about his basic law and then trusting them to use it where relevant).

Third, the "determining" step tells the doctor to determine the level of the relevant metabolites in the blood, through whatever process the doctor or the laboratory wishes to use. As the patents state, methods for determining metabolite levels were well known in the art. '623 patent, col. 9, ll. 12–65, 2 App. 11. Indeed, scientists routinely measured metabolites as part of their investigations into the relationships between metabolite levels and efficacy and toxicity of thiopurine compounds. '623 patent, col. 8, ll. 37–40, *id.*, at 10. Thus, this step tells doctors to engage in well-understood, routine, conventional activity previously engaged in by scientists who work in the field. Purely "conventional or obvious" "[pre]-solution activity" is normally not sufficient to transform an unpatentable law of nature into a patent-eligible application of such a law. *Flook*, 437 U. S., at 590; see also *Bilski*, 561 U. S., at 610–611 ("[T]he prohibition against patenting abstract ideas 'cannot be circumvented by' . . . adding 'insignificant postsolution activity'" (quoting *Diehr*, 450 U. S., at 191–192)).

Fourth, to consider the three steps as an ordered combination adds nothing to the laws of nature that is not already present when the steps are considered separately. See *id.*, at 188 ("[A] new combination of steps in a process may be patentable even though all the constituents of the combination were well known and in common use before the combination was made"). Anyone who wants to make use of these laws must first administer a thiopurine drug and measure the resulting metabolite concentrations, and so the combination amounts to nothing significantly more than an instruction to doctors to apply the applicable laws when treating their patients.

The upshot is that the three steps simply tell doctors to gather data from which they may draw an inference in light of the correlations. To put the matter more succinctly, the claims inform a relevant audience about certain laws of nature; any additional steps consist of well-understood, routine,

conventional activity already engaged in by the scientific community; and those steps, when viewed as a whole, add nothing significant beyond the sum of their parts taken separately. For these reasons we believe that the steps are not sufficient to transform unpatentable natural correlations into patentable applications of those regularities.

B

1

A more detailed consideration of the controlling precedents reinforces our conclusion. The cases most directly on point are *Diehr* and *Flook*, two cases in which the Court reached opposite conclusions about the patent eligibility of processes that embodied the equivalent of natural laws. The *Diehr* process (held patent eligible) set forth a method for molding raw, uncured rubber into various cured, molded products. The process used a known mathematical equation, the Arrhenius equation, to determine when (depending upon the temperature inside the mold, the time the rubber had been in the mold, and the thickness of the rubber) to open the press. It consisted in effect of the steps of: (1) continuously monitoring the temperature on the inside of the mold, (2) feeding the resulting numbers into a computer, which would use the Arrhenius equation to continuously recalculate the mold-opening time, and (3) configuring the computer so that at the appropriate moment it would signal "a device" to open the press. *Diehr*, 450 U. S., at 177–179.

The Court pointed out that the basic mathematical equation, like a law of nature, was not patentable. But it found the overall process patent eligible because of the way the additional steps of the process integrated the equation into the process as a whole. Those steps included "installing rubber in a press, closing the mold, constantly determining the temperature of the mold, constantly recalculating the appropriate cure time through the use of the formula and a digital computer, and automatically opening the press at the

proper time." *Id.*, at 187. It nowhere suggested that all these steps, or at least the combination of those steps, were in context obvious, already in use, or purely conventional. And so the patentees did not "seek to pre-empt the use of [the] equation," but sought "only to foreclose from others the use of that equation in conjunction with all of the other steps in their claimed process." *Ibid.* These other steps apparently added to the formula something that in terms of patent law's objectives had significance—they transformed the process into an inventive application of the formula.

The process in *Flook* (held not patentable) provided a method for adjusting "alarm limits" in the catalytic conversion of hydrocarbons. Certain operating conditions (such as temperature, pressure, and flow rates), which are continuously monitored during the conversion process, signal inefficiency or danger when they exceed certain "alarm limits." The claimed process amounted to an improved system for updating those alarm limits through the steps of: (1) measuring the current level of the variable, *e. g.*, the temperature; (2) using an apparently novel mathematical algorithm to calculate the current alarm limits; and (3) adjusting the system to reflect the new alarm-limit values. 437 U. S., at 585–587.

The Court, as in *Diehr*, pointed out that the basic mathematical equation, like a law of nature, was not patentable. But it characterized the claimed process as doing nothing other than "provid[ing] a[n unpatentable] formula for computing an updated alarm limit." *Flook*, *supra*, at 586. Unlike the process in *Diehr*, it did not "explain how the variables used in the formula were to be selected, nor did the [claim] contain any disclosure relating to chemical processes at work or the means of setting off an alarm or adjusting the alarm limit." *Diehr*, *supra*, at 192, n. 14; see also *Flook*, 437 U. S., at 586. And so the other steps in the process did not limit the claim to a particular application. Moreover, "[t]he chemical processes involved in catalytic conversion of

hydrocarbons[,] . . . the practice of monitoring the chemical process variables, the use of alarm limits to trigger alarms, the notion that alarm limit values must be recomputed and readjusted, and the use of computers for 'automatic monitoring-alarming'" were all "well known," to the point where, putting the formula to the side, there was no "inventive concept" in the claimed application of the formula. *Id.*, at 594. "[P]ost-solution activity" that is purely "conventional or obvious," the Court wrote, "can[not] transform an unpatentable principle into a patentable process." *Id.*, at 589, 590.

The claim before us presents a case for patentability that is weaker than the (patent-eligible) claim in *Diehr* and no stronger than the (unpatentable) claim in *Flook*. Beyond picking out the relevant audience, namely, those who administer doses of thiopurine drugs, the claim simply tells doctors to: (1) measure (somehow) the current level of the relevant metabolite, (2) use particular (unpatentable) laws of nature (which the claim sets forth) to calculate the current toxicity/inefficacy limits, and (3) reconsider the drug dosage in light of the law. These instructions add nothing specific to the laws of nature other than what is well-understood, routine, conventional activity, previously engaged in by those in the field. And since they are steps that must be taken in order to apply the laws in question, the effect is simply to tell doctors to apply the law somehow when treating their patients. The process in *Diehr* was not so characterized; that in *Flook* was characterized in roughly this way.

2

Other cases offer further support for the view that simply appending conventional steps, specified at a high level of generality, to laws of nature, natural phenomena, and abstract ideas cannot make those laws, phenomena, and ideas patentable. This Court has previously discussed in detail an English case, *Neilson*, which involved a patent claim that posed

a legal problem very similar to the problem now before us. The patent applicant there asserted a claim

> "for the improved application of air to produce heat in fires, forges, and furnaces, where a blowing apparatus is required. [The invention] was to be applied as follows: The blast or current of air produced by the blowing apparatus was to be passed from it into an air-vessel or receptacle made sufficiently strong to endure the blast; and through or from that vessel or receptacle by means of a tube, pipe, or aperture into the fire, the receptacle be kept artificially heated to a considerable temperature by heat externally applied." *Morse*, 15 How., at 114–115.

The English court concluded that the claimed process did more than simply instruct users to use the principle that hot air promotes ignition better than cold air, since it explained how the principle could be implemented in an inventive way. Baron Parke wrote (for the court):

> "It is very difficult to distinguish [Neilson's claim] from the specification of a patent for a principle, and this at first created in the minds of some of the court much difficulty; but after full consideration, we think that the plaintiff does not merely claim a principle, but a machine embodying a principle, and a very valuable one. We think the case must be considered as if the principle being well known, the plaintiff had first invented a mode of applying it by a mechanical apparatus to furnaces; and his invention then consists in this—by interposing a receptacle for heated air between the blowing apparatus and the furnace. In this receptacle he directs the air to be heated by the application of heat externally to the receptacle, and thus he accomplishes the object of applying the blast, which was before of cold air, in a heated state to the furnace." *Neilson* v. *Harford*, Webster's Patent Cases, at 371.

Thus, the claimed process included not only a law of nature but also several unconventional steps (such as inserting the receptacle, applying heat to the receptacle externally, and blowing the air into the furnace) that confined the claims to a particular, useful application of the principle.

In *Bilski* the Court considered claims covering a process for hedging risks of price changes by, for example, contracting to purchase commodities from sellers at a fixed price, reflecting the desire of sellers to hedge against a drop in prices, while selling commodities to consumers at a fixed price, reflecting the desire of consumers to hedge against a price increase. One claim described the process; another reduced the process to a mathematical formula. 561 U. S., at 599. The Court held that the described "concept of hedging" was "an unpatentable abstract idea." *Id.*, at 611. The fact that some of the claims limited hedging to use in commodities and energy markets and specified that "well-known random analysis techniques [could be used] to help establish some of the inputs into the equation" did not undermine this conclusion, for "*Flook* established that limiting an abstract idea to one field of use or adding token postsolution components did not make the concept patentable." *Id.*, at 612.

Finally, in *Benson* the Court considered the patentability of a mathematical process for converting binary-coded decimal numerals into pure binary numbers on a general purpose digital computer. The claims "purported to cover any use of the claimed method in a general-purpose digital computer of any type." 409 U. S., at 64, 65. The Court recognized that "'a novel and useful structure created with the aid of knowledge of scientific truth'" might be patentable. *Id.*, at 67 (quoting *Mackay Radio*, 306 U. S., at 94). But it held that simply implementing a mathematical principle on a physical machine, namely, a computer, was not a patentable application of that principle. For the mathematical formula had "no substantial practical application except in connection

with a digital computer." *Benson*, *supra*, at 71. Hence the claim (like the claims before us) was overly broad; it did not differ significantly from a claim that just said "apply the algorithm."

3

The Court has repeatedly emphasized this last mentioned concern, a concern that patent law not inhibit further discovery by improperly tying up the future use of laws of nature. Thus, in *Morse* the Court set aside as unpatentable Samuel Morse's general claim for "'the use of the motive power of the electric or galvanic current . . . however developed, for making or printing intelligible characters, letters, or signs, at any distances,'" 15 How., at 86 (history of the case). The Court explained:

> "For aught that we now know some future inventor, in the onward march of science, may discover a mode of writing or printing at a distance by means of the electric or galvanic current, without using any part of the process or combination set forth in the plaintiff's specification. His invention may be less complicated—less liable to get out of order—less expensive in construction, and in its operation. But yet if it is covered by this patent the inventor could not use it, nor the public have the benefit of it without the permission of this patentee." *Id.*, at 113.

Similarly, in *Benson* the Court said that the claims before it were "so abstract and sweeping as to cover both known and unknown uses of the [mathematical formula]." 409 U. S., at 67, 68. In *Bilski* the Court pointed out that to allow "petitioners to patent risk hedging would pre-empt use of this approach in all fields." 561 U. S., at 612. And in *Flook* the Court expressed concern that the claimed process was simply "a formula for computing an updated alarm limit," which might "cover a broad range of potential uses." 437 U. S., at 586.

These statements reflect the fact that, even though rewarding with patents those who discover new laws of nature and the like might well encourage their discovery, those laws and principles, considered generally, are "the basic tools of scientific and technological work." *Benson*, *supra*, at 67. And so there is a danger that the grant of patents that tie up their use will inhibit future innovation premised upon them, a danger that becomes acute when a patented process amounts to no more than an instruction to "apply the natural law," or otherwise forecloses more future invention than the underlying discovery could reasonably justify. See generally Lemley, Risch, Sichelman, & Wagner, Life After *Bilski*, 63 Stan. L. Rev. 1315 (2011) (hereinafter Lemley) (arguing that § 101 reflects this kind of concern); see also C. Bohannan & H. Hovenkamp, Creation Without Restraint: Promoting Liberty and Rivalry in Innovation 112 (2012) ("One problem with [process] patents is that the more abstractly their claims are stated, the more difficult it is to determine precisely what they cover. They risk being applied to a wide range of situations that were not anticipated by the patentee"); W. Landes & R. Posner, The Economic Structure of Intellectual Property Law 305–306 (2003) (The exclusion from patent law of basic truths reflects "both . . . the enormous potential for rent seeking that would be created if property rights could be obtained in them and . . . the enormous transaction costs that would be imposed on would-be users [of those truths]").

The laws of nature at issue here are narrow laws that may have limited applications, but the patent claims that embody them nonetheless implicate this concern. They tell a treating doctor to measure metabolite levels and to consider the resulting measurements in light of the statistical relationships they describe. In doing so, they tie up the doctor's subsequent treatment decision whether that treatment does, or does not, change in light of the inference he has drawn

using the correlations. And they threaten to inhibit the development of more refined treatment recommendations (like that embodied in Mayo's test) that combine Prometheus' correlations with later discovered features of metabolites, human physiology, or individual patient characteristics. The "determining" step too is set forth in highly general language covering all processes that make use of the correlations after measuring metabolites, including later discovered processes that measure metabolite levels in new ways.

We need not, and do not, now decide whether were the steps at issue here less conventional, these features of the claims would prove sufficient to invalidate them. For here, as we have said, the steps add nothing of significance to the natural laws themselves. Unlike, say, a typical patent on a new drug or a new way of using an existing drug, the patent claims do not confine their reach to particular applications of those laws. The presence here of the basic underlying concern that these patents tie up too much future use of laws of nature simply reinforces our conclusion that the processes described in the patents are not patent eligible, while eliminating any temptation to depart from case law precedent.

III

We have considered several further arguments in support of Prometheus' position. But they do not lead us to adopt a different conclusion. First, the Federal Circuit, in upholding the patent eligibility of the claims before us, relied on this Court's determination that "[t]ransformation and reduction of an article 'to a different state or thing' is *the clue* to the patentability of a process claim that does not include particular machines." *Benson*, *supra*, at 70–71 (emphasis added); see also *Bilski*, *supra*, at 602–603; *Diehr*, 450 U. S., at 184; *Flook*, *supra*, at 588, n. 9; *Cochrane* v. *Deener*, 94 U. S. 780, 788 (1877). It reasoned that the claimed processes are therefore patent eligible, since they involve transforming the

human body by administering a thiopurine drug and transforming the blood by analyzing it to determine metabolite levels. 628 F. 3d, at 1356–1357.

The first of these transformations, however, is irrelevant. As we have pointed out, the "administering" step simply helps to pick out the group of individuals who are likely interested in applying the law of nature. See *supra*, at 78. And the second step could be satisfied without transforming the blood, should science develop a totally different system for determining metabolite levels that did not involve such a transformation. See *supra*, at 87. Regardless, in stating that the "machine-or-transformation" test is an "*important and useful clue*" to patentability, we have neither said nor implied that the test trumps the "la[w] of nature" exclusion. *Bilski*, 561 U. S., at 603 (emphasis added). That being so, the test fails here.

Second, Prometheus argues that, because the particular laws of nature that its patent claims embody are narrow and specific, the patents should be upheld. Thus, it encourages us to draw distinctions among laws of nature based on whether or not they will interfere significantly with innovation in other fields now or in the future. Brief for Respondent 42–46; see also Lemley 1342–1344 (making similar argument).

But the underlying functional concern here is a *relative* one: how much future innovation is foreclosed relative to the contribution of the inventor. See *supra*, at 86. A patent upon a narrow law of nature may not inhibit future research as seriously as would a patent upon Einstein's law of relativity, but the creative value of the discovery is also considerably smaller. And, as we have previously pointed out, even a narrow law of nature (such as the one before us) can inhibit future research. See s*upra*, at 86–87.

In any event, our cases have not distinguished among different laws of nature according to whether or not the princi-

ples they embody are sufficiently narrow. See, *e. g.*, *Flook*, 437 U. S. 584 (holding narrow mathematical formula unpatentable). And this is understandable. Courts and judges are not institutionally well suited to making the kinds of judgments needed to distinguish among different laws of nature. And so the cases have endorsed a bright-line prohibition against patenting laws of nature, mathematical formulas, and the like, which serves as a somewhat more easily administered proxy for the underlying "building-block" concern.

Third, the Government argues that virtually any step beyond a statement of a law of nature itself should transform an unpatentable law of nature into a potentially patentable application sufficient to satisfy § 101's demands. Brief for United States as *Amicus Curiae*. The Government does not necessarily believe that claims that (like the claims before us) extend just minimally beyond a law of nature should receive patents. But in its view, other statutory provisions—those that insist that a claimed process be novel, 35 U. S. C. § 102, that it not be obvious in light of prior art, § 103, and that it be "full[y], clear[ly], concise[ly], and exact[ly]" described, § 112—can perform this screening function. In particular, it argues that these claims likely fail for lack of novelty under § 102.

This approach, however, would make the "law of nature" exception to § 101 patentability a dead letter. The approach is therefore not consistent with prior law. The relevant cases rest their holdings upon §101, not later sections. *Bilski*, *supra; Diehr*, *supra; Flook*, *supra; Benson*, 409 U. S. 63. See also H. R. Rep. No. 1923, 82d Cong., 2d Sess., 6 (1952) ("A person may have 'invented' a machine or a manufacture, which may include anything under the sun that is made by man, *but it is not necessarily patentable under section 101* unless the conditions of the title are fulfilled" (emphasis added)).

We recognize that, in evaluating the significance of additional steps, the § 101 patent-eligibility inquiry and, say, the § 102 novelty inquiry might sometimes overlap. But that need not always be so. And to shift the patent-eligibility inquiry entirely to these later sections risks creating significantly greater legal uncertainty, while assuming that those sections can do work that they are not equipped to do.

What role would laws of nature, including newly discovered (and "novel") laws of nature, play in the Government's suggested "novelty" inquiry? Intuitively, one would suppose that a newly discovered law of nature is novel. The Government, however, suggests in effect that the novelty of a component law of nature may be disregarded when evaluating the novelty of the whole. See Brief for United States as *Amicus Curiae* 27. But §§ 102 and 103 say nothing about treating laws of nature as if they were part of the prior art when applying those sections. Cf. *Diehr*, 450 U. S., at 188 (patent claims "must be considered as a whole"). And studiously ignoring *all* laws of nature when evaluating a patent application under §§ 102 and 103 would "make all inventions unpatentable because all inventions can be reduced to underlying principles of nature which, once known, make their implementation obvious." *Id.*, at 189, n. 12. See also Eisenberg, Wisdom of the Ages or Dead-Hand Control? Patentable Subject Matter for Diagnostic Methods After *In re Bilski*, 3 Case W. Res. J. L. Tech. & Internet 1, 54–55 (2012); 2 D. Chisum, Patents § 5.03[3] (2005).

Section 112 requires only a "written description of the invention . . . in such full, clear, concise, and exact terms as to enable any person skilled in the art . . . to make and use the same." It does not focus on the possibility that a law of nature (or its equivalent) that meets these conditions will nonetheless create the kind of risk that underlies the law of nature exception, namely, the risk that a patent on the law

would significantly impede future innovation. See Lemley 1329–1332 (outlining differences between §§ 101 and 112); Eisenberg, *supra*, at 59–61 (similar). Compare Risch, Everything Is Patentable, 75 Tenn. L. Rev. 591 (2008) (defending a minimalist approach to § 101), with Lemley (reflecting Risch's change of mind).

These considerations lead us to decline the Government's invitation to substitute §§ 102, 103, and 112 inquiries for the better established inquiry under § 101.

Fourth, Prometheus, supported by several *amici*, argues that a principle of law denying patent coverage here will interfere significantly with the ability of medical researchers to make valuable discoveries, particularly in the area of diagnostic research. That research, which includes research leading to the discovery of laws of nature, is expensive; it "ha[s] made the United States the world leader in this field"; and it requires protection. Brief for Respondent 52.

Other medical experts, however, argue strongly against a legal rule that would make the present claims patent eligible, invoking policy considerations that point in the opposite direction. The American Medical Association, the American College of Medical Genetics, the American Hospital Association, the American Society of Human Genetics, the Association of American Medical Colleges, the Association for Molecular Pathology, and other medical organizations tell us that if "claims to exclusive rights over the body's natural responses to illness and medical treatment are permitted to stand, the result will be a vast thicket of exclusive rights over the use of critical scientific data that must remain widely available if physicians are to provide sound medical care." Brief for American College of Medical Genetics et al. as *Amici Curiae* 7; see also App. to Brief for Association Internationale pour la Protection de la Propriété Intellectuelle et al. as *Amici Curiae* A6, A16 (methods of medical treatment are not patentable in most of Western Europe).

We do not find this kind of difference of opinion surprising. Patent protection is, after all, a two-edged sword. On the one hand, the promise of exclusive rights provides monetary incentives that lead to creation, invention, and discovery. On the other hand, that very exclusivity can impede the flow of information that might permit, indeed spur, invention, by, for example, raising the price of using the patented ideas once created, requiring potential users to conduct costly and time-consuming searches of existing patents and pending patent applications, and requiring the negotiation of complex licensing arrangements. At the same time, patent law's general rules must govern inventive activity in many different fields of human endeavor, with the result that the practical effects of rules that reflect a general effort to balance these considerations may differ from one field to another. See Bohannan & Hovenkamp, Creation Without Restraint, at 98–100.

In consequence, we must hesitate before departing from established general legal rules lest a new protective rule that seems to suit the needs of one field produce unforeseen results in another. And we must recognize the role of Congress in crafting more finely tailored rules where necessary. Cf. 35 U. S. C. §§ 161–164 (special rules for plant patents). We need not determine here whether, from a policy perspective, increased protection for discoveries of diagnostic laws of nature is desirable.

* * *

For these reasons, we conclude that the patent claims at issue here effectively claim the underlying laws of nature themselves. The claims are consequently invalid. And the Federal Circuit's judgment is reversed.

It is so ordered.