The Fine-Tuning Argument for God's Existence

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Abstract

This paper has two main objectives. The first is to justify the value of pursuing a science-based argument for God's existence within the framework of the Torah. The second is to present a clear, well-formulated, albeit brief version of the fine-tuning argument for God's existence from modern physics.

History of Jewish Attempts to Argue for God's Existence through Science and Philosophy

There is a long record of Jewish thinkers arguing for the existence of God based on science and philosophy. These proofs span, for example, from the midrash's portrayal of Avraham's encounter with the lighthouse[1] to great medieval scholars like Rambam, Saadiah Gaon, Bachya ibn Pekudah, and many others throughout the generations.

Those arguments for God were all grounded in the science and philosophy of their times. Of course, those who formulated them had no

1 *Bereishis Rabbah* 39:1.

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other options—one can only work within the framework of available knowledge. These great thinkers cannot be faulted for failing to predict the modern scientific revolution. When the scientific framework of their arguments was overturned, some of their arguments were overturned along with it.[2]

Perhaps the most famous example of this is the argument recorded by Rambam in the first chapter of the *Mishneh Torah*. He argued that the constant motion of the heavenly spheres demonstrated the existence of an infinitely powerful God who causes this motion. This argument depends on the Aristotelian scientific view that constant motion needs a cause. But the fall of Aristotelian science and the rise of modern science was founded, among other things, on Galileo's principle of inertia, which says that an object in motion will stay in motion unless interfered with by an external source.[3]

While arguments grounded in Aristotelian science no longer seem valid, what does modern science have to say about the existence of God?

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2 This is not the case for design arguments like that of Bachya ibn Pekudah. In *Chovos HaLevavos*, he writes: "There are some people who claim that the world came into being by chance, without a Creator who created it and without a Maker who formed it. It is amazing to me how a rational, healthy human being could entertain such a notion. If such a person heard someone else saying the same thing about a water wheel, which turns to irrigate part of a field or a garden, saying that it came to be without a craftsman who designed it and toiled to assemble it and placed each part for a useful purpose—the hearer would be greatly amazed about him, consider him a complete fool, and be swift to call him a liar and reject his words. And since he would reject such a notion for a mere simple, insignificant water wheel, which requires but little ingenuity and which improves but a small portion of the earth—how could he permit himself to entertain such a notion for the entire universe which encompasses the earth and everything in it, and which exhibits a wisdom that no rational human intellect is capable of fathoming, and which is prepared for the benefit of the whole earth and everything on it. How could one claim that it came to be without purposeful intent and thought of a capable wise Being?"
Though the particulars of such arguments may change, the basic line of reasoning stands the test of time. This paper presents a type of modern-day design argument and discusses why Darwin's theory of evolution does not undermine design arguments in general.

3 While modern science would seem to make Rambam's argument obsolete, this point is not fully clear. In his 2017 book, *Five Proofs of the Existence of God,* (San Francisco: Ignatius Press, 2017), philosopher Edward Feser argues that while Aristotle's argument is formulated in terms of motion, it is not truly based on motion, but on change. As such, he maintains that the argument is still valid despite the principle of inertia.

Are the New Atheists correct in their claim that modern science undermines the existence of God? Or, conversely, does modern science—just like ancient science—provide a compelling argument for God? This paper answers this last question in the affirmative and presents an argument for God's existence from modern physics—specifically from the fine-tuning of the constants of nature.

Three Motivations for a Science-Based Argument for God's Existence

One may question the value of Torah Jews pursuing an argument for God's existence from modern science. After all, what is wrong with the other methods of embracing God's existence (e.g. faith, authority, spiritual experiences, etc.)?

We shall present three reasons modern Jews should pursue an argument for God's existence from science: A) to answer skeptics and deniers; B) to increase their knowledge of God; and C) to further develop their love and awe of God.

A. Answering Skeptics and Deniers

In the Mishnah in *Avot* 2:14, Rabbi Elazar says we should "Know what to respond to a heretic." Rabbeinu Yonah[4] explains that if we do not have answers to the questions of heretics, the world will see this and learn from their bad beliefs, ultimately leading to a desecration of God's name. While these remarks specifically address heretical questions on the Torah, it stands to reason that heretical attacks against God Himself should be treated with at least the same, if not greater, concern for the desecration of His name.

For much of world history, most thinkers believed in a supreme deity or a creator.[5] More recent history, however, has seen many secular philosophers and scientists who have denied God's existence. In 1882, Friedrich Nietzsche infamously proclaimed, "God is dead," and the New Atheists and many modern scientists launched attacks on the belief in God. For example, biologist Richard Dawkins wrote *The God Delusion* (Boston: Houghton Mifflin, 2006) to popularize skepticism about God's existence. Though in previous generations these attacks were largely limited to

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[4] Rabbeinu Yonah: רבי אלעזר אומר הוי שקוד ללמוד תורה ודע מה שתשיב את אפיקורוס. שיקבע עצמו ללמוד תורה כדי שידע להשיב על דברי האפיקורוס שאם לא ישיבוהו כפי טענותיו ושקריו ילמדו העולם מהם וישתו מים הרעים בראותם כי נוצח אותו ונמצא שם שמים מתחלל.

[5] מִי לֹא יִרָאֲךָ מֶלֶךְ הַגּוֹיִם כִּי לְךָ יָאֱתָה כִּי בְכָל־חַכְמֵי הַגּוֹיִם וּבְכָל־מַלְכוּתָם מֵאַיִן כָּמוֹךָ (*Yirmiyahu* 10:7). Also, see *Malachi* 1:11, *Menachot* 110a, and Rambam, *Avodah Zarah* 1:1.

scholarly works that were largely inaccessible to the average Jew, modern universities have brought these aggressive attacks to our classrooms, and the internet has brought them to our children's attention.

As Rabbeinu Yonah suggested, if we ignore these attacks, we give the world the impression that they are correct. We allow our scientifically-minded children to think that these questions have no rational answers and that God is "make-believe." While this might not be the case for every child, it is the sentiment of some of our best and brightest.

We must prevent this type of desecration of God's name and show the world, and our children alike, that the scientific establishment has no successful critique against the existence of God; on the contrary, modern physics provides a compelling argument in favor of God's existence. While we are unlikely to convince skeptics and deniers, it behooves today's Jewish leadership to follow the advice of Rabbi Elazar and to "know what to respond to a heretic."

B. Increased Knowledge of God

Even if someone were to think that they never interact with heretics (something increasingly difficult nowadays) and therefore have no need to find answers to heretical questions, an intrinsic motivation still exists to seek out a compelling argument for God's existence from modern science: to increase one's knowledge and conviction of God's existence.

If one already believes in God, how could one benefit from finding a science-based argument for His existence? The benefit derives from the fact that conviction is not black or white but is subject to variation of degree. One can be partly convinced that something is true and then, as one's knowledge increases, becomes even more convinced. In that vein, knowing God involves a lifetime pursuit of studying God, His Torah, and His universe to arrive at a deeper and more convincing knowledge of His existence.

To elucidate this point, consider the distinction between firsthand and secondhand knowledge.[6] Firsthand knowledge consists of the things you verify for yourself and therefore have direct knowledge about their truth. Secondhand knowledge consists of things you know because a trusted authority tells you they are true.[7]

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6 For a discussion of these two types of knowledge, see *Chovos HaLevavos: The Gate of Unity*.

7 There is very little that is known *entirely* based upon firsthand knowledge; even scientific knowledge itself is generally based upon the experimental results of others. Nonetheless, some forms of knowledge are more grounded in firsthand

Though these are two distinct types of knowledge, they are not mutually exclusive. You may originally learn an idea from someone else but eventually become convinced of its truth for yourself. In such a case, your secondhand knowledge leads to firsthand knowledge. For example, when you first learn that smoking is unhealthy, you accept it because you trust that doctors and scientists are experts regarding this conclusion. However, once you understand the science, you no longer need to rely on the authority of doctors and scientists—you see the truth of the statement firsthand. For many people, this firsthand knowledge will be more impactful than the knowledge conveyed by authority.

Similarly, you might have secondhand knowledge that God exists based on the teachings of your parents, teachers, or society. These rational and reliable sources of knowledge of God are part of the foundation of our acceptance of the Torah. Nevertheless, you can go beyond secondhand knowledge and attempt to ground your conviction in God's existence in a compelling science-based argument.

To see the value of basing your conviction of God's existence on firsthand knowledge, consider *Shemot* 20:18, where God instructs Moshe to tell the Jews, "You have seen that from the heavens, I have spoken to you." If all types of knowledge were the same, why would it be relevant that they saw it? Rashi (based on *Mechilta*) explains: "There is a difference between what a person sees and what he is told by others, because that which he is told by others, sometimes his heart is divided about believing it."

Rashi here is conveying that a person is sometimes skeptical of secondhand knowledge. This is especially true regarding knowledge of a Being that a person cannot see, hear, or know through direct observations. If a person bases their knowledge of God's existence only on the authority of others, their inner skeptic may at times relate to Him as make-believe. God told Bnei Yisrael that they should have no such doubts. After all, they perceived God speaking to them from the heavens.

While this worked for them, what about us? We did not see God speak to us from the heavens! Herein lies the value of firsthand knowledge. If you increase your conviction about God's existence through a compelling science-based argument, you can embrace God as being as real as everything with which you interact and see. You can avoid the doubts that Rashi says can emerge from reliance on secondhand knowledge alone. As Rambam says in the *Moreh HaNevuchim* 2:33, God's existence and His Oneness (the first two of the Ten Commandments) can

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analysis (together with very reliable secondhand knowledge), while others are almost entirely secondhand.

be known to a prophet and a regular person in the same way because they can be rationally demonstrated. Therefore, whenever it is possible to go beyond reliance on authority and gain firsthand knowledge that God exists, one can thereby attain a greater conviction in the reality of God's existence.[8]

Besides the higher level of conviction that attends firsthand knowledge, there is an additional value in going beyond secondhand knowledge and seeing how the truth of an idea is justified. When you merely accept an idea, it remains isolated from all other ideas in your mind. You cannot see how it fits into your bigger picture of reality. You may not appreciate how your other ideas could be influenced by this idea or how this idea can be impacted by all your other ideas. When the knowledge is firsthand, it allows you to understand and integrate it into a larger framework of ideas.

In this vein, one can either take God's existence as a fact because his parents or authority figures told him so, or because of a direct existential/spiritual awareness in conjunction with support from authority. However, if he also then investigates the reality of God through intellectually contemplating the universe, he then sees how God fits into his picture of reality. He views God as the author of the laws of nature or as the One Who caused all matter and spacetime at the beginning of the universe.

This knowledge of God is deeper and richer than a mere acceptance of God's existence. It relates to everything else he knows to be real, and it informs all his other ideas by relating them to the ultimate cause responsible for their existence. While he can certainly get by with a basic ac-

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[8] Perhaps this approach can help answer the question asked by Rav Chasdai Crescas (in the introduction to *Or HaShem*) against Rambam's first mitzvah of knowing God. He points out that Rambam's mitzvah to know God seems circular: if we do not already know that He exists, why would we listen to His mitzvah in the first place? And if we do already know that He exists, have we not already fulfilled it? Based upon the above, we can answer that it is not circular. While the premise of the mitzvah is that we have basic secondhand knowledge that God exists and commanded the mitzvah, the mitzvah directs us to pursue greater conviction through other methods such as acquiring firsthand knowledge. For related answers to this question, see *Radvaz* (*Metzudas David* to Mitzvah 1), *Malbim, Shemot* 20:2, Abarbanel, *Rosh Amanah* 11, and "Is Belief in God a Mitzvah? Maimonides on the First Commandment" by Rabbi Assaf Bednarsh, https://www.ou.org/chag/files/2020/05/R-Bednarsh-article.pdf.

ceptance of God, his knowledge of God can be greatly enhanced by studying the universe and seeing how the idea of God emerges as the source of all reality.[9]

C. To Further Develop Love and Awe of God

Even if one secludes himself from all encounters with skeptics and deniers and is content with his belief in God based on faith or secondhand knowledge, there would still be tremendous value in understanding the science involved in the fine-tuning argument for God's existence. This is because it plays a role in developing his love and awe of God.

Rambam in *Yesodei HaTorah* 2:2 writes that the method to fulfill the commandments to love and revere God is to study the wonders and wisdom manifest in His universe:

> What is the path to loving and revering Him? When a person contemplates His great and wondrous actions and creations and sees from them His unlimited and incomparable wisdom, immediately he loves, praises, glorifies, and has a tremendous yearning to know the great God, as David said (*Tehillim* 42:3): "My soul thirsts for God, for the living Almighty." And when he thinks about these very things, he is taken aback and is frightened and knows that he is a small, lowly, dark creature who stands with weak, small knowledge before a Perfect Mind, as David said (*Tehillim* 8:5): "When I see Your heavens, the work of Your fingers, what is man that You should remember him?" And, in line with these matters, I will explain major categories regarding the actions of the Master of the Universe so that they will be an opening for an understanding person to love God. Like our Sages say regarding love, "Because through this you will recognize the One who said, and the world came into being."[10]

Rambam further emphasizes that one's love of God is only in proportion to the degree one studies and understands the different areas of

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9 This may be why Rambam in *Hilchos Yesodei HaTorah* 1:5 includes in the mitzvah of knowing God that "…המצוי הזה הוא אלוה העולם אדון כל הארץ והוא המנהיג הגלגל, This Existence is the God of the universe, Master of the Earth, and the One Who causes the rotation of the sphere…" Part of knowing God involves seeing firsthand how everything else that you know is dependent on Him.

10 It should be noted that in *Sefer HaMitzvos*, Positive Mitzvah 3, Rambam includes study of God's Torah alongside the study of His universe as the routes towards fulfilling the mitzvah of loving God. He says: היא שצונו באהבתו יתעלה. וזה שנחשוב ונתבונן במצותיו ומאמריו ופעולותיו עד שנשיגהו ונהנה בהשגתו בתכלית ההנאה, וזאת היא האהבה המחוייבת

science and wisdom that lead a person to God. At the end of *Sefer HaMadda*, he writes:

> One only loves the Holy One Blessed is He with the knowledge that he knows of Him. And in accordance with one's knowledge is the love: if it is a little, it is a little; and if it is a lot, it is a lot. Therefore, a person needs to devote himself to understanding and conceptualizing the wisdom and sciences that make him know his Creator in accordance with the person's ability to understand and comprehend, as we explained in the Laws of the Foundations of the Torah.

While this love and awe can emerge from any encounter with wisdom of God's universe, arguments for God's existence from science often bring one face-to-face with great wisdom that leads directly to God. Nevertheless, not all arguments are the same. There are two reasons.

First, different presentations of the same argument invoke differing degrees of knowledge of the natural world. For example, the short version of Rambam's argument in *Mishneh Torah* contains much less science and philosophy than the lengthier presentation of the same argument at the beginning of *Book Two* of *Moreh HaNevuchim*. The more detailed presentation will naturally reveal more insight into the wisdom in God's universe and lead to a greater love and awe of God.

Second, different classes of arguments for God's existence intrinsically involve varying amounts of science and therefore lead to different degrees of appreciation of the wisdom manifest in His universe. For example, the first cause or unmoved mover arguments are not directly based on the great wisdom manifest throughout the universe. Even though they necessarily give a person some knowledge about the universe, there is a limit to the love and awe of God they engender.

On the other hand, this paper presents a type of design argument (a fine-tuning argument, to be precise) that of necessity involves encountering the pervasive wisdom in God's creation. The entire argument is founded on the scientific knowledge of the constants of nature and the discovery that the complex universe (containing atoms, molecules, planets, stars, life, and galaxies) is dependent on the precision of God's fine-tuned laws.

Therefore, even if one already accepts the existence of God, studying the fine-tuning argument with its associated scientific knowledge provides a valuable glimpse into the infinite wisdom manifest in the foundations of God's universe, thereby leading to increased love and awe of God.

Addressing Dangers and Concerns

Despite the above motivations for pursuing a science-based argument for God's existence, modern Jewish thinkers may hesitate to rekindle this ancient pursuit. They may sense potential dangers and pitfalls of such attempts.

It Implies the Rejection of Non-Science-Based Faith

First, there is the concern that presenting any science-based argument could imply that if one's faith is not rationally grounded, then it has no basis. Against this backdrop, modern Jews who are not fully convinced through such rational arguments might be led to drop their faith.

To guard against this possibility, we want to clearly state that a science-based rational argumentation is not the only legitimate method of establishing a religious belief. Different people have different routes toward accepting God's existence. We would thus not suggest that anyone abandon their current method of gaining conviction that God exists. We propose only that modern science provides a compelling method to know God's existence. While this approach can be used to reinforce one's belief in God's existence or establish it for someone who does not have a prior belief, it should not be interpreted as the only viable method of knowing God exists.

Perhaps Modern Science Will Be Overturned

A second concern is that modern science may one day be overturned in the same manner as Aristotelian science was, leaving modern arguments for God in the same place as Rambam's argument. Given that possibility, one could argue that perhaps it would be wiser to learn from history and realize that these types of arguments do not stand the test of time.

We have three answers to this objection:

(i) Just as we treat our bodies with cutting-edge modern medicine despite the potential that it may be overturned (as bloodletting was), it behooves us to provide our minds with cutting-edge science-based evidence for God's existence, despite the potential that it may be overturned (as ancient arguments were). In other words, we are compelled to navigate this world using the modern medicine and science that is currently available.

(ii) Despite the potential for modern science to be overturned, many people embrace science as the gold standard for attaining knowledge and making decisions. These people will only be satisfied by a convincing rational science-based argument for God's existence. There are yet others

who aren't so extreme in their reliance on modern science but will nevertheless be greatly impacted by an argument based upon well-accepted scientific discoveries. It is neither wise nor fair to ignore a convincing argument from modern science because of the fear that it might be disproved at a later date.

(iii) Even if modern science changes in a way that undermines our argument, other routes toward accepting the existence of God would be unaffected. Thus, there is minimal risk in presenting and evaluating a modern science-based argument for God's existence.[11]

What About the Other Fundamentals of Judaism?

A third objection contends that even if the fine-tuning argument can provide a convincing argument for God, can the same be done for all the other fundamentals of our religion, e.g., prophecy, Divine providence, and the divinity of the Torah? If not, what does demonstrating the existence of God really accomplish? In other words, if we cannot provide a rational argument to support *all* the fundamental principles of Judaism, what is the point of trying to establish even one principle? Ultimately, we need to resort to secondhand knowledge and faith!

We have two answers to this important question:

(i) The firm establishment of God's existence can lay the foundation for further knowledge. For example, it puts one in a much stronger position to embrace the fact that God gave the Torah—whether through a firsthand demonstration or a secondhand acceptance of authority. If one attempts to demonstrate the divinity of the Torah in a first-hand manner,[12] the burden of proof is less if one already knows that God exists. And even if one does not seek a firsthand demonstration of the divinity of the Torah, but accepts it based on secondhand knowledge, this knowledge will be more firmly rooted if it is built upon the sturdy foundation of firsthand knowledge of God's existence.

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11 Additionally, in the conclusion of this paper, we will illustrate how a version of the fine-tuning argument was known to Chazal and Rishonim and we will show why there is good reason to believe that this argument, in one form or other, will continue to stand the test of time.

12 Some sources presenting such arguments include: our Rebbe, Yisroel Chait's *Torah from Sinai* (https://www.ybt.org/essays/rchait/tsinai.pdf), essays in *Strauss, Spinoza & Sinai: Orthodox Judaism and Modern Questions of Faith* (2022), Dovid Gottlieb's *Reason to Believe* (Jerusalem: Feldhein, 2017), and Lawrence Kelemen's *Permission to Believe* (New York: Targum/Feldheim, 1990).

(ii) In *Moreh HaNevuchim*, Rambam goes to great lengths to provide evidence for the existence of God and to demonstrate that this evidence is not contingent on whether one accepts the theory of the creation of the universe[13] or the theory of the eternity of the universe.[14,15] We can derive from Rambam that one should not dismiss what he *can* know firsthand merely because he cannot know everything in this manner. In other words, any knowledge about reality is good, even if it is not full knowledge of everything.

Fine-Tuning Argument[16]

Given the long history of Jewish thinkers providing rational arguments for God's existence and the three aforementioned motivations for providing a modern science-based argument, let us move to the second part of this paper which presents the fine-tuning argument for God's existence.

The fine-tuning argument arises naturally from studying the fundamental elements of our physical universe.[17] As such, before we begin the argument or present any discussion about God, let us introduce some basic ideas in modern physics.

Fundamental Constants and a Theory of Everything

Three key terms lie at the heart of modern physics: (i) fundamental physics; (ii) constants of nature; and (iii) theory of everything.

(i) "Fundamental" signifies the most basic, irreducible entity in any area of analysis. *Fundamental physics* studies the most basic elements of physics

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13 Rambam (*Peirush HaMishnayos, Sanhedrin, Perek Chelek*) includes creation as a part of the fourth fundamental principle of the Torah even though he cannot prove it by philosophical demonstration.

14 In 1:71, Rambam expresses the value of demonstrating the existence of God independently from creation of the universe. He subsequently devotes the beginning of Book 2 towards presenting these demonstrations.

15 As an aside, modern cosmology's discovery of the big bang provides a very strong case for creation of the universe. This is a good illustration of the fact that modern science can provide supports for fundamental beliefs of the Torah that were unavailable to earlier generations.

16 While this paper presents a brief version of the fine-tuning argument, the argument is developed in more depth in the first five episodes of season one of the *Physics to God* podcast.

17 This is in contrast to arguments for God which emerge from cherry-picking some unexplained detail or gap in scientific understanding.

and, by extension, the natural world. Within fundamental physics, the universe is conceived as being composed of *fundamental particles* whose interactions are governed by *fundamental laws*.

Fundamental particles are the most basic building blocks from which everything else is comprised. For example, people are made of cells that are made of molecules that are made of atoms that are made of fundamental particles like electrons and quarks. If instead of starting with people, you had started with trees, rocks, stars, planets, or anything else in our universe, you would have found that everything was ultimately made of the same basic components. These building blocks that cannot themselves be further subdivided are called fundamental particles.

The fundamental laws of nature are the most basic laws that cannot be derived from simpler laws. For example, the laws of chemistry are not fundamental insofar as they can be derived from the laws of physics. On the other hand, the laws of physics, such as gravity and quantum mechanics, are currently considered fundamental laws insofar as they seemingly cannot be derived from anything more basic.[18]

(ii) The *constants of nature* are approximately 25 fixed numbers that reflect the quantities of the fundamental particles and laws. One example is the constant that determines the mass of every electron (i.e., how much a single electron weighs). While physicists cannot derive this number from any theoretical considerations, careful measurements have shown that it is always 9.109×10^{-31} kg.[19] This tiny mass is approximately 1/1836 the mass of a proton (a ratio that will be significant later on).

Another constant involves the electromagnetic force. This force can be seen as a qualitative rule in physics that two particles with similar charges (e.g., two electrons) repel. How quantitatively strong is the electromagnetic repulsion between two electrons? The strength of this force is determined by a number called the fine structure constant which is

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[18] If physicists find a theory that unifies gravity and quantum mechanics, then this theory would be considered fundamental, and gravity and quantum mechanics would then be derived.

[19] While this constant can be represented differently if the units are changed, one way to see that the quantity isn't truly dependent on any particular unit is to consider the ratio of the masses of two particles. As illustrated above (regarding the electron and the proton), this results in a pure number (1/1836) without any units.

measured to be around 1/137.035999139.[20] This results in the electromagnetic force between two electrons being about 10^{42} times stronger than the gravitational force between them.

(iii) The idea of a *theory of everything* can best be introduced by a quote from Albert Einstein: "In the whole history of science from Greek philosophy to modern physics there have been attempts to reduce the apparent complexity of natural phenomena to some simple fundamental idea and relationships. This is the underlying principle of all natural philosophy."[21]

This principle forms the basis of a dream harbored by physicists for about a century. They hope they will discover one simple, elegant equation that will encapsulate everything we know about fundamental physics. Once scientists discover this one master law, they would theoretically be able to derive all other known laws of physics, and consequently all other non-fundamental sciences (like chemistry and astronomy). In this sense, this master law would be known as a theory of everything (a.k.a., a final theory).[22]

The Mystery of The Constants

To date, physicists have been partially successful in their pursuit of a theory of everything. One major hurdle left to overcome—which we will not delve into in this paper—is the difficult task of unifying gravity with quantum mechanics, showing how they can both be derived from one greater law. The other major challenge comes from the 25 constants of nature.

To appreciate the problem the constants of nature pose to a theory of everything, consider that the goal of physics, and science in general, is to make sense of and explain everything we observe. As Einstein noted, science accomplishes this task by simplifying and reducing phenomena to their most fundamental elements. Scientists' repeated successes in this pursuit have led them to hope and expect that the fundamental laws of reality will be unified, simple, and beautiful.

Steven Weinberg elaborates on the fascinating property of the beauty of a theory:

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[20] This is a dimensionless constant—a pure number without any units. For a rough analogy that illustrates how this is possible, consider the probability of flipping a head on a coin. This is ½, a number with no units.

[21] Albert Einstein and Leopold Infeld, *The Evolution of Physics*, (New York: Simon and Schuster, 1938) p. 52.

[22] For more about this dream, see physicist Steven Weinberg's 1992 book, *Dreams of a Final Theory* (New York: Pantheon Books, 1992).

> There is no logical formula that establishes a sharp dividing line between a beautiful explanatory theory and a mere list of data, but we know the difference when we see it—we demand a simplicity and rigidity in our principles before we are willing to take them seriously. Thus, not only is our aesthetic judgment a means to the end of finding scientific explanations and judging their validity—it is part of what we mean by an explanation.[23]

The 25 constants of nature, which seem like a "mere list of data," present a problem. They are called fundamental constants of nature because they appear to be essential, irreducible elements that evade any explanation or derivation from something simpler. But they appear to be arbitrary, complex, ugly numbers with no rhyme or reason. They offend the sense of beauty that physicists seek in a theory of everything and fly in the face of physicists' pursuit of unity and simplicity. In a word, they are the exact opposite of what physicists intuit lies at the base of reality. For this reason, physicists resisted accepting the constants as fundamental, brute facts with no cause or deeper explanation.

In his discussion of the constants, physicist Richard Feynman described the great mystery they pose:

> There is a most profound and beautiful question associated with the observed coupling constant... It is a simple number that has been experimentally determined to be close to 0.08542455. (My physicist friends won't recognize this number, because they like to remember it as the inverse of its square: about 137.03597 with about an uncertainty of about 2 in the last decimal place. It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.) Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest damn mysteries of physics: a magic number that comes to us with no understanding by man. You might say the "hand of God" wrote that number, and "we don't know how He pushed his pencil." We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of dance to do on the computer to make this number come out, without putting it in secretly![24]

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23 *Dreams of a Final Theory* (1992), p. 148.

24 Richard P. Feynman, *QED: The Strange Theory of Light and Matter* (Princeton, NJ: Princeton University Press, 1985), p. 129.

Feynman is implicitly dismissing as likely the possibility that the constants are deterministically derived from a deeper mathematical theory. While not impossible, it did not seem plausible that physicists would be able to derive all 25 numbers from entirely qualitative principles.[25]

We can simply formulate Feynman's great mystery of the constants as: How could 25 seemingly arbitrary and complex numbers truly be fundamental? And if they are not fundamental, how could physicists possibly find a deeper theory that would explain the values of the constants?

Before moving on, we would like to point out that the mystery of the constants itself does not point to God. Though Feynman's quote mentioned God, he used the term metaphorically (as he was an atheist). If one were to simply invoke God to plug the "gap" in knowledge and solve the mystery of the seemingly arbitrary numbers, this would not provide any insight into the constants but would be guilty of "God of the Gaps" reasoning.[26]

The Discovery of Fine-Tuning

Towards the end of the 20th century, evidence started mounting that provided an important clue for solving the mystery of the constants. Physicists discovered that the values of the constants were not as arbitrary as they had seemed. Quite the contrary, they were remarkably fine-tuned. On a basic level, this means that if the values of the constants were slightly different, then our universe would not be complex, structured, and ordered. That is, different values of the constants would result in a universe with no atoms, molecules, planets, life, stars, or galaxies.

On a deeper level, scientists discovered that if the values of the constants were different, then even though fundamental physics would be essentially unchanged, that which emerges from fundamental physics would be drastically different. While there would still be a universe with fundamental particles governed by fundamental physical laws, there would be no chemistry, biology, astronomy, etc. In other words, scientists discovered that the only reason all the other branches of science exist is

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[25] Feynman writes about the numerous failed attempts over the decades to reduce the constants to combinations of mathematical constants (such as *e* or *pi*). There were also attempts during the late 1970s and 1980s, that Feynman doesn't discuss, of deriving three of the constants from deeper principles via Grand Unified Theories. These too failed, and over the ensuing four decades no progress has been made in this direction.

[26] This logical fallacy, a type of argument from ignorance, is employed to plug a hole in our current understanding of the universe by saying, "God did it." Below, we will provide several illustrations of why our formulation of the fine-tuning argument does not commit the God of the Gaps fallacy.

because the quantities of nature are precisely fine-tuned to allow for the natural emergence of all the complex entities beyond fundamental particles.

To illustrate the meaning of fine-tuning, we shall briefly mention a few examples. The first involves the masses of the various components of atoms. In general, atoms are comprised of protons and neutrons (in a nucleus) that are orbited by electrons. Electrons are tiny when compared to both protons and neutrons. Specifically, the mass of an electron is 1/1836 of the mass of a proton and 1/1838 of the mass of a neutron. Scientists discovered that if an electron were a bit bigger than its measured mass (2.5 times its actual tiny size), electrons and protons in an atom would combine to produce neutrons, resulting in disaster for the universe as we know it.[27] The only reason this does not happen is because of fine-tuning—the mass of an electron is too small to add to the mass of the proton and make a neutron.

The next example of fine-tuning involves the fine structure constant, the number (1/137.035999139) that determines the strength of the electromagnetic repulsion between particles with the same electric charge (like the positively charged protons in an atom). If the fine structure constant were increased by a few percent, then the force of repulsion between protons would rip the atom apart and prevent the formation of any heavier atoms, like carbon and oxygen. Without heavier atoms, it would be impossible to have complex molecules, planets, or life.[28]

The last and most striking example of fine-tuning involves the cosmological constant, a number that determines the expansion rate of the universe, which for a long time was thought to be zero. Theoretically, physicists knew that this constant could have any value; but if it was not zero, they calculated that it had to be a very small number. This is because

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27 John D. Barrow and Frank J. Tipler, *The Anthropic Cosmological Principle* (Oxford: Oxford University Press, 1986), p. 400 describe the disastrous situation that would result if electrons were a little bit bigger: "This would lead to a world in which stars and planets could not exist. These structures, if formed, would decay into neutrons by proton-electron annihilation (meaning, protons and electrons would combine, and you end up with only neutrons). If that were to happen, no atoms would ever have formed, and we would not be here to know it."

28 Leonard Susskind, *The Cosmic Landscape: String Theory and the Illusion of Intelligent Design* (New York: Little, Brown, 2005), p. 175. describes some of the many significant consequences that would occur if the fine structure constant had a different value: "What if the fine structure constant were bigger, say about one? This would create several disasters, one of which would endanger the nucleus. Why is the fine structure constant small? No one knows. But if it were bigger, there would be no one to ask the question."

if it were too big (whether a big positive or negative number), then it would be impossible for the universe to exist as it does. More specifically, a positive number that was too big would have caused the universe to expand too quickly and be unable to form galaxies; a negative number that was too big would have caused the universe to collapse on itself right after the big bang. Since it seemed virtually impossible for nature to "produce" such a tiny, non-zero number, physicists assumed that there must be some qualitative reason why it was exactly zero.[29]

Then, in 1998, astronomers found a way to measure the accelerated expansion rate of the universe. They discovered that the cosmological constant was not zero. Instead, it was an incredibly tiny number, approximately 10^{-122}—that is a decimal point followed by 121 zeroes and then a 1! If this value had been even a little bigger or smaller, then galaxies would not exist. Because this degree of fine-tuning was recognized as something that no scientist could chalk up to a lucky accident, it became the impetus for many scientists to take fine-tuning seriously.[30]

As we discussed earlier, before the discovery of fine-tuning, there were two possible explanations for the value of the constants—that they were brute fundamental facts of reality or that they are derived from some deeper mathematical theory. Feynman's great mystery was based on the fact that these were both very poor explanations for the constants' mysterious values.

As implausible as these theories were, the discovery of fine-tuning invalidated them. This is because they both ignore the most significant scientific knowledge about the constants, namely, that they are fine tuned. Both theories would need to posit that the intrinsically necessary values of the constants coincidently happen to be the fine-tuned values needed for the future emergence of a complex universe with atoms, molecules, planets, stars, life, and galaxies. Physicist Frank Wilczek expressed this

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29 It is very plausible to eventually find a qualitative reason, such as symmetry or canceling, for a value of zero.

30 Leonard Susskind (ibid, p. 88) expresses his amazement by such a small number that isn't exactly zero: "When we combine the theory of elementary particles with the theory of gravity, we discover the horror of a cosmological constant big enough to not only destroy galaxies, stars, and planets but also atoms, and even protons and neutrons—unless. Unless what? Unless the various bosons, fermions, masses, and coupling constants that go into calculating the vacuum energy conspire to cancel the first 119 decimal places. But what natural mechanism could ever account for such an unlikely state of affairs? Are the Laws of Physics balanced on an incredibly sharp knife-edge, and if so, why? Those are the big questions."

point as follows: "It is logically possible that parameters determined uniquely by abstract theoretical principles just happen to exhibit all the apparent fine-tunings required to produce, by a lucky coincidence, a universe containing complex structures. But that, I think, really strains credulity."[31]

As time went on, and more and more examples of fine-tuning were discovered, a scientific consensus emerged: the constants of nature are not arbitrary numbers—as they had seemed in Feynman's time—but are precisely fine-tuned.[32] Scientists faced the new challenge of finding the

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31 Frank Wilczek, "On Absolute Units, III: Absolutely Not?" *Physics Today* 59 (2006), https://pubs.aip.org/physicstoday/article-abstract/59/5/10/750480/On-Absolute-Units-III-Absolutely-Not?redirectedFrom=fulltext.

32 Astrophysicist Luke Barnes, an expert on fine-tuning, says as follows: "There are a great many scientists, of varying religious persuasions, who accept that the universe is fine tuned for life, e.g., Barrow, Carr, Carter, Davies, Dawkins, Deutsch, Ellis, Greene, Guth, Harrison, Hawking, Linde, Page, Penrose, Polkinghorne, Rees, Sandage, Smolin, Susskind, Tegmark, Tipler, Vilenkin, Weinberg, Wheeler, Wilczek. They differ, of course, on what conclusion we should draw from this fact." The Fine-Tuning of the Universe for Intelligent Life, http://dx.doi.org/10.1071/AS12015

The following are from non-theistic, world-renowned scientists that are quoted by Barnes. In addition to supporting that our universe is fine-tuned, they help elucidate the basic concepts surrounding fine-tuning:

> "Life appears to depend upon delicate coincidences that we have not been able to explain. The broad outlines of that situation have been apparent for many decades. When less was known it seemed reasonable to hope that better understanding of symmetry and dynamics would clear things up. Now that hope seems much less reasonable. The happy coincidences between life's requirements and nature's choices of parameter-values might be just a series of flukes, but one could be forgiven for beginning to suspect that something deeper is at work." Frank Wilczek, "Enlightenment, Knowledge, Ignorance, Temptation," https://arxiv.org/abs/hep-ph/0512187.
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> "Most of the fundamental constants in our theories appear fine-tuned in the sense that if they were altered by only modest amounts, the universe would be qualitatively different, and in many cases unsuitable for the development of life. … The emergence of the complex structures capable of supporting intelligent observers seems to be very fragile. The laws of nature form a system that is extremely fine-tuned, and very little in physical law can be altered without destroying the possibility of the development of life as we know it." Steven Hawking & Leonard Mlodinow, *The Grand Design* (New York: Bantam Books, 2010), p. 161.

proper interpretation for fine-tuning. The question became: What does the scientific discovery of fine-tuning tell us about the cause of the constants?

Fine-Tuning Implies an Intelligent Fine Tuner

The scientific knowledge of fine-tuning demonstrates that out of the vast set of theoretically possible values for the constants, their actual values are precisely those needed to produce our complex universe. This surprising discovery reveals that the values of the constants are not arbitrary, random numbers but are precise values selected for the purpose of bringing about our complex universe.

Given that the constants have a purpose, we can now ask a basic question: What type of cause acts with a purpose? In other words, what does the discovery that the fine-tuned constants have the objective of producing our complex universe tell us about the cause that set their values?

"Any universe hospitable to life—what we might call a biophilic universe—has to be 'adjusted' in a particular way. The prerequisites for any life of the kind we know about—long-lived stable stars, stable atoms such as carbon, oxygen and silicon, able to combine into complex molecules, etc.—are sensitive to the physical laws and to the size, expansion rate and contents of the universe. Indeed, even for the most open-minded science fiction writer, 'life' or 'intelligence' requires the emergence of some generic complex structures: it can't exist in a homogeneous universe, not in a universe containing only a few dozen particles. Many recipes would lead to stillborn universes with no atoms, no chemistry, and no planets; or to universes too short-lived or too empty to allow anything to evolve beyond sterile uniformity." Martin Rees, "Numerical coincidences and 'tuning' in cosmology," https://arxiv.org/abs/astro-ph/0401424

"The existence of an amazingly strong correlation between our own properties and the values of many parameters of our world, such as the masses and charges of electron and proton, the value of the gravitational constant, the amplitude of spontaneous symmetry breaking in the electroweak theory, the value of the vacuum energy, and the dimensionality of our world, is an experimental fact requiring an explanation." Andrei Linde, "Inflationary Cosmology," https://arxiv.org/abs/0705.0164v2

"Our universe is much more complex than most universes with the same laws but different values of the parameters of those laws. In particular, it has a complex astrophysics, including galaxies and long-lived stars, and a complex chemistry, including carbon chemistry. These necessary conditions for life are present in our universe as a consequence of the complexity which is made possible by the special values of the parameters." Lee Smolin, "Scientific alternatives to the anthropic principle," https://arxiv.org/abs/hep-th/0407213v3

Since the definition of intelligence is the ability to select one option from the set of many possible choices for the purpose of achieving a particular objective,[33] the straightforward answer is that the precise values of the constants were selected by an intelligent cause for the purpose of bringing about a universe with atoms, molecules, planets, life, stars, and galaxies.

Let us clarify and formalize the line of reasoning that allows us to interpret fine-tuning as evidence for an intelligent cause of our universe:

(i) We began with Feynman's mystery of the constants, what he called one of the greatest mysteries in physics: How could physicists possibly find a deeper theory that would explain the values of 25 seemingly arbitrary numbers? (It is important to note that the mystery of the constants itself has nothing to do with fine-tuning, but is rather an intrinsic mystery that lies at the heart of physicists' dream of discovering the most fundamental reality of the universe.)

(ii) Scientific progress slowly revealed that the constants of nature exhibit fine-tuning. From among the vast amount of theoretically allowed values, their specific values have been shown to be necessary for bringing about a complex and ordered universe that is much greater than the sum of its simple parts.

(iii) The term "intelligence" refers to the ability to pick or select one possibility from among many for the purpose of producing an intended goal.

Combining these three points, we argue:

(iv) The cause of the fine-tuning of the constants is intelligent.[34]

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33 The Latin etymology of intelligent is from *inter* "between" and *legere* "choose."

34 We think it is a mistake to overreach, as many do, and attempt to use the discovery of fine-tuning to posit that the sole purpose of the laws and constants of nature is intelligent life. While the evidence of fine-tuning justifies the inference that God intelligently selected the right values for the constants needed to eventually yield our amazing complex universe filled with atoms, molecules, planets, stars, galaxies, *and* life, there is little evidence that indicates that the purpose of God's fine-tuning was intelligent life alone. While life, and especially intelligent life, is special, so are stars and galaxies. As the Gemara often says, "If you try to grab too much, you grab nothing at all."

Both scientists and religious people often say the constants are fine tuned for life. Scientists say it because their interpretation of fine-tuning—the multiverse—relies on an intelligent observer bias (as we shall explain soon). Religious people say it because they want the argument to establish Divine providence to humanity. Nevertheless, while it is true that without atoms, molecules, planets, stars, and galaxies there would be no intelligent life, that does not mean that the

Why the Fine-Tuning Argument Is Not God of the Gaps

There is a common misconception that the fine-tuning argument merely attempts to plug gaps in our current understanding of the universe through positing God. To understand why this critique is inapplicable to our formulation of the fine-tuning argument, let us first identify three characteristic flaws of the God of the Gaps fallacy:

1) *Argument from Ignorance*: God of the Gaps reasoning does not follow from a direct inference to God but from a lack of knowledge.
2) *Gaps Are Details*: A particular gap about a detail in a robust scientific theory is likely due to our insufficient knowledge and is not an indication of either the failure of the scientific theory or the hand of God.
3) *Explains Anything and Everything*: A theory of the gaps posits something—whether it is God, luck, or anything else—as a solution to every gap in knowledge. Since this type of answer can be used to explain anything at all, it explains nothing.

Let us now see why our formulation of the fine-tuning argument does not suffer from any of these problems.

1) *Argument from Knowledge*: The inference of intelligence from fine-tuning is not an argument from ignorance. Rather, it is based upon scientific knowledge that the values of the constants are not arbitrary as they had appeared, but are precisely fine-tuned to bring about a universe with atoms, molecules, planets, life, stars, and galaxies. This is not based upon a gap but upon scientific discoveries.
2) *Foundational Issue*: A lack of understanding regarding the foundation of a subject is entirely different than a gap in the details of a subject whose foundations are well understood. While a gap in the details is likely to be filled upon gaining more knowledge, a foundational problem often demands a new type of explanation. Since the problem of explaining the fundamental constants is a problem with the very foundation of physics, not a mere detail, it is not an argument of the gaps.
3) *Cannot Explain a Disordered Universe*: The theory of an intelligent cause is a valid inference only because we have observed a complex, ordered, and structured universe. On the other hand, if the universe were observed to be disordered chaos with arbitrary fundamental

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purpose of everything is intelligent life. The simplest interpretation is that the purpose of the constants is the universe in all its complexity and grandeur, of which intelligent life is but one, albeit special, part. See Rambam in *Moreh Ha-Nevuchim* 3:13 for more on this point.

constants, intelligence would then be a bad explanation. Since an intelligent cause cannot explain any possible universe, it is not a plug that can fill any gap.

The Multiverse Interpretation of Fine-Tuning

Many scientists are unhappy with the idea of an intelligent cause. Nevertheless, even if they refuse to accept the indication of God, physicists realize that a paradigm shift is needed to explain how the purpose of attaining our complex universe can possibly be the cause of the fine-tuned values of the constants.[35]

The solution for many, if not most, physicists is to explain our one observable universe by positing a multiverse—an infinite number of unobservable parallel universes with different values for the constants of nature. While the idea of a multiverse was for a long time relegated to science fiction and fantasy, it has now entered mainstream science.

Let us see how the multiverse explains that the purpose implied by our universe's fine-tuned constants is a mere illusion. If all these hypothesized universes actually exist, then a tiny fraction of the universes would, by chance alone, happen to possess fine-tuned constants that would allow for the emergence of intelligent observers like ourselves. The fact that we happen to be in such a "lucky" universe is the result of observer bias: only

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[35] To better understand why fine-tuning demands a paradigm shift from the scientific perspective of the past few centuries, let us first note that there are different frameworks for explaining the causes of phenomena in the universe, i.e., why things are the way they are. The two relevant ones are efficient causes and teleological causes. An efficient cause refers to the agent or force that brings a thing into existence or initiates a change; a teleological cause refers to a thing's purpose or objective. While teleological causes were a significant part of Aristotelian science, modern science and the scientific method attempt to explain the natural world exclusively through efficient causes. However, fine-tuning seems to introduce teleological causes back into the picture.

To see this, let us compare the standard scientific paradigm with the paradigm implied by fine-tuning. In the standard paradigm, physicists discover laws of nature that explain the phenomena we observe. For instance, they formulate fixed laws of nature that determine that one atom will collide with another and cause a complex molecule to result. This framework exclusively uses efficient causes to explain a molecule's formation. But fine-tuning implies the opposite, that the purpose of producing a complex molecule (and all other complex phenomena in our universe) causes the specific quantities of the laws of nature. In this perspective, the resultant universe is the teleological cause of the value of the constants. This "reverse causation" cannot fit into the normal framework of efficient causation to which scientists are accustomed.

intelligent beings could formulate the question of why the values of the constants are what they are, and those intelligent observers could only exist in a universe with fine-tuned constants. In short, the theory of a multiverse maintains that the constants do not actually have a purpose—it just looks that way from our limited perspective. Scientists refer to this explanation as the *anthropic principle*.[36]

It should be clear that invoking an intrinsically untestable hypothesis like infinitely many unobservable, disordered universes to explain our one observed ordered universe is quite a stretch. Recognizing that the top physicists in the world posit something as wild and speculative as an infinite number of parallel universes further demonstrates that fine-tuning is a serious problem that necessitates a paradigm shift in how modern science conceives of the world. An explanation for the fine-tuned constants of nature must posit something beyond our one universe: either God or the multiverse.[37]

Fine-Tuning in Physics vs. Design in Biology

Throughout history, many thinkers have formulated the design argument based upon the wonders of biology. They have attempted to show that the diversity and complexity of life on Earth must have resulted from an intelligent designer.[38] However, Darwin's theory of evolution via natural selection has led atheistic scientists to argue that science can explain the

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36 This point involves a historical irony. The anthropic principle, used by atheistic scientists, places humans in a unique position where our very existence places constraints on the constants of nature that we are potentially able to observe. In contrast, our argument infers that an intelligent cause fine-tuned the constants for the purpose of bringing about a complex, ordered, and structured universe with atoms, molecules, planets, stars, galaxies, and intelligent life. This line of reasoning treats life as something on par with the rest of the universe.

37 It is beyond the scope of this paper to explain the multiverse in more detail and show exactly why, even in its own framework, it fails as a valid scientific explanation. For an extensive analysis and rejection of the multiverse, you can listen to season two of the *Physics to God* podcast, or read a summary of the core points in our article, "Is the Multiverse Real?" at https://www.physicstogod.com/is-the-multiverse-real.

38 A well-known modern example is William Paley, *Natural Theology; or, Evidences of the Existence and Attributes of the Deity* (London: J. Faulder, 1802), which presents his "watchmaker analogy" to argue for the existence of a designer who designed our universe.

diversity of life on Earth without an intelligent cause.[39] While we will not address this controversial debate, we will point out significant advantages of the fine-tuning argument in physics over the design argument in biology.

First, physics is fundamental. It cannot be derived from anything else. Biology is not. Because the laws and constants of physics are fundamental, any attempt to explain their fine-tuning must posit something beyond the observable universe. Therefore, it is compelling that one must arrive at something like God (or the multiverse) as an explanation for fine-tuning. On the other hand, because life is not fundamental, there is nothing intrinsic that necessitates looking outside the universe to explain design in biology. It is theoretically possible—albeit quite difficult—for science to show that all the design in biology naturally emerges from blind processes in physics and chemistry.

The advantage of the argument for God's existence from physics over biology can be seen by comparing the alternative theories proposed by atheistic scientists in their respective fields. In biology, the alternative theory to an intelligent designer is evolution, a scientific theory with significant empirical support. Therefore, the design argument in biology must argue against many scientists about the success and comprehensiveness of evolution as a scientific theory. In contrast, the alternative theory to an intelligent cause in physics is the multiverse, an unverified theory of an infinite number of unobservable universes. As a consequence, proponents of the fine-tuning argument in physics do not argue with scientists about the science itself. There is near scientific consensus that the constants are fine-tuned, and the only argument between those accepting the fine-tuning argument and scientists is about the proper philosophical conclusion to infer from the accepted science—God or the multiverse.

On a deeper level, even if biologists could fully explain the natural origin and subsequent evolution of life, it is a mistake to suggest that this shows that life on Earth is merely the result of blind chance. This is because the living organisms of biology are built from the atoms and complex molecules of chemistry (such as carbon, oxygen, and water) that themselves are dependent on the fine-tuned laws of fundamental physics. As such, if the constants of nature were not set just right, there would be no stable atoms, no complex molecules, no planets, no stars, and consequently, no life. In other words, the fine-tuning argument in physics

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[39] A well-known modern example is Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design* (New York: W. W. Norton, 1986), which compares Darwin's theory of evolution to a blind watchmaker that naturally causes the unfolding of life on Earth.

shows that an intelligent cause fine-tuned the fundamental laws of physics in a manner that atoms, molecules, planets, stars, and one day, biological life, would naturally emerge.[40]

Who Fine-Tuned God?

To conclude the argument that fine-tuning leads to God, the following problems must be addressed: (i) One can argue that an intelligent fine-tuner is not a good solution to the problem of fine-tuning because it merely begs the question of who fine-tuned the intelligent fine tuner; (ii) How does the fine-tuning argument show that the intelligent fine tuner is the God of the Torah and not the god of some other religion, a genius alien, or an intelligent robot that creates universes?

The short answer to both these questions is that if someone tried to use the fine-tuning argument to infer a complex god made of various parts, they would indeed be begging the question: Who designed and fine-tuned the various parts of god? However, since God is absolutely simple—the Torah's idea of *Yichud HaShem*[41]—we can understand why it is not sensible to ask who fine-tuned God—because He has no parts that are subject to design or fine-tuning.

Thus, the fine-tuning argument (as well as design arguments in general) points directly to the God of Abraham—a genuine monotheistic deity who is absolutely simple—as the only satisfactory explanation for the fine-tuning of the constants. While any notion of god being a complex existence is subject to the line of questioning of who fine-tuned it, the God of genuine monotheism allows this the line of questioning to stop at a satisfactory point—a point at which we can understand why any further questioning is inapplicable.[42]

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40 For more details on the differences between the fine-tuning argument in physics and the design argument in biology, see https://www.physicstogod.com/3-proofs-of-god-from-science from the subsection, "Proving God: Physics vs. Biology" until the end of the article.

41 Rambam, *Hilchos Yesodei HaTorah* 1:7; *Chovos HaLevavos*: *The Gate of Unity*; Saadiah Gaon, *Beliefs and Opinions: Treatise* II.

42 While we are only scratching the surface of the answer to this question, we plan to release an extensive discussion about one simple God in season three of the *Physics to God* podcast. We shall discuss what we can and cannot know about God as well as answer commonly asked questions about God, all using analogies from modern physics and its analysis of the fundamentals of our universe. We hope to summarize our arguments in a paper about *Yichud HaShem*.

Conclusion

The scientific knowledge of fine-tuning demonstrates that of the vast set of theoretically possible values for the constants, their actual values are precisely those needed to produce our complex universe. This surprising discovery reveals that the values of the constants are not arbitrary, random numbers but are rather precise values selected by an intelligent cause, God, for the purpose of bringing about our complex universe.

We do not think the fine-tuning argument, either in its current or modified form, will ever be invalidated. Nature, like halachah, incorporates both qualities *and* quantities—and quantities matter! As modern science has gained more knowledge about the natural world, the degree of known fine-tuning has progressively increased. While we cannot absolutely prove that this will continue, there is every reason to believe it will.

The enduring nature of the fine-tuning argument is further reinforced from the fact that Chazal and the Rishonim presented their own version of it. Saadiah Gaon and Abarbanel maintain that the name of God, Shadai, refers to the fact that God fixed the perfect quantities in His universe.[43] This is based on the Gemara which says that when God was creating the universe, it was expanding like two balls of thread until He said, "*dai*," enough.[44] God is called Sha-dai because He is the One *she'amar la'olam dai*, Who said to the world, "Enough!"[45] While the importance of quantities in God's creation was recognized by Chazal, the great significance of the name Sha-dai is even more manifest in the context of modern physics, whose discoveries have revealed the great role of mathematics, quantity, and fine-tuning in God's universe.

Besides providing compelling evidence for God's existence, the fine-tuning of the constants provides an extraordinary and accessible illustration of the great wisdom manifested in God's creation of the universe. In the spirit of Rambam's description of love and awe of God (cited earlier), when one sees and appreciates this wisdom, he is filled with a great love of God and a strong desire to know Him. And, when he reflects on the smallness of his own wisdom compared to God's infinite wisdom as expressed in the fine-tuned universe, he is moved towards a great awe of God, the intelligent cause of our entire universe. ☙

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43 Abarbanel, *Shemos* 6:3.

44 *Chagigah* 12a.

45 The Gemara cites another example of this fine-tuning in that God precisely fixed sea-level to rise just enough.