

Stem Cell Technology and In Vitro Fertilization: A Possible Halakhic Solution for Avoiding Mamzerut

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Abstract

We propose a potential halakhic solution—using stem cells and in vitro fertilization—to enable a Jewish individual classified as a *mamzer* to have children who are not.

Introduction

Over the past decade, there have been major advances in stem cell technologies. Although there are only a few FDA-approved stem cell therapies, more protocols are expected to be approved soon. In April of 2023, the FDA approved a recently developed technique, “cord blood-based cell therapy,” designed to quicken the recovery of neutrophils (a subset of white blood cells) in the body and thereby reduce the risk of infection in cancer patients undergoing treatment. In this protocol, stem cells are obtained from the umbilical cord blood of a newborn and transplanted into cancer patients to fight infections. In December of 2023, the FDA approved an important treatment for sickle cell anemia,¹ a devastating genetic disease that affects almost 100,000 Americans. Patients with sickle cell anemia were successfully treated using a combination of stem cell

¹ <https://www.nbcnews.com/health/health-news/fda-approves-cure-sickle-cell-disease-first-treatment-use-gene-editing-rcna127979>.

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therapy and gene editing technologies. As scientists learn more about controlling the plasticity of stem cells, new advances in stem cell technology will focus on treating some of the most devastating diseases that plague human beings, including Alzheimer's disease, diabetes, and infertility.

Stem cell treatments are based on our understanding of how to transform either an embryonic stem cell or an adult stem cell into any type of human cell. Over the past two decades, Nobel Prize technologies have been developed to convert an adult cell into an embryonic stem cell² and then reprogram that pluripotent stem³ cell to become any of over 200 different cell types. Our DNA encodes about 25,000 genes, but different cell types utilize only a fraction of these genes. A muscle cell may only use 8000 of its genes, while turning off the other 17,000 genes. The mechanisms that turn genes on and off in any cell are regulated, in large measure, by 1600 specific proteins called transcription proteins. Scientists are learning how to operate specific transcription proteins to transform any adult cell (such as a skin cell) into an embryonic stem cell or to turn any embryonic stem cell into another adult cell (such as a muscle cell or neuron).

Stem cell therapy is currently being used to treat patients with type I diabetes. Type I diabetes develops in people whose immune system identifies the beta cells of the pancreas as alien cells and selectively destroys them. Without functioning pancreatic beta cells, the pancreas fails to monitor blood sugar levels and to secrete insulin, a critical hormone that regulates homeostatic blood sugar levels. Using innovative stem cell encapsulation technologies,⁴ scientists can create nanoparticles containing healthy beta pancreatic cells bioengineered from stem cells. These nanoparticles are partially porous, allowing for the movement of sugar and insulin in and out of the particles while also serving as a cellular barrier. This procedure protects the stem cells' destruction by recipient's immune system and prevents the escape of stem cells from the particles.

- ² Embryonic stem cells are found in the inner cell mass of the human blastocyst, an early stage of the developing embryo lasting from the 4th to 7th day after fertilization. These cells have the potential to differentiate (or transform) into any one of the 200 types of cells that comprise the human body.
- ³ Pluripotent cells are the embryonic stem cells that have the capacity to divide, self-renew, and differentiate into cells of early primary germ cell layers, namely mesoderm, endoderm, and ectoderm, or they can transform into any type of cell in the human body.
- ⁴ Cell encapsulation is a method to create a protein/lipid shield around a group of cells to protect cells after they enter the body during treatments such as cell therapy. Encapsulation shields the cells from the natural processes of the immune system, which include recognizing and destroying foreign bodies.

There are other futuristic applications of stem cell technology that may affect human infertility. Scientists can isolate skin stem cells (with all 23 pairs of chromosomes) from a skin patch obtained from an infertile person and transform these cells into gamete-like cells (like sperm and eggs, containing half the number of chromosomes). These gamete-like cells do not appear as normal sperm or eggs but can be successfully used to create a human zygote, via in vitro fertilization (IVF) technologies. For example, an infertile male who cannot produce sperm can use his skin or blood cells as a stem cell source to create gamete-like cells that can then be fused with his partner's egg in the laboratory to create a zygote. Similarly, stem cells from the skin of an infertile woman can be transformed into a gamete-like cell to be fused with her partner's sperm in the laboratory to form a zygote. These zygotes can then be used via IVF to produce a healthy child.

In general, the use of stem cell technology to treat human diseases does not pose significant halakhic issues because treating diseases or saving lives is one of the highest ethical priorities in halakhah.⁵ There may be some halakhic issues, however, relating to someone volunteering to enter a stem cell clinical trial before FDA approval.⁶ In addition, there may be some halakhic issues whether a patient is obligated to pay the potentially exorbitant fees for stem cell therapies.⁷ However, most halakhic scholars evaluate these halakhic issues on a case-by-case basis.

Here, we present a different application of stem cell technology for a non-medical situation. Specifically, can stem cells be used with IVF to allow a *mamzer* who is married to a Jewish partner to have a non-*mamzer* child?

Halakhic Issues Regarding *Mamzer* Status

A *mamzer*⁸ is a child born from a forbidden sexual union, such as an incestual or adulterous affair. That child is called a *mamzer* and traditional

⁵ Leviticus (18:5) and *Yoma* 85b.

⁶ M. D. Tendler and J. D. Loike, "Mitochondrial replacement therapy: halachic considerations for enrolling in an experimental clinical trial," *Rambam Maimonides Medical Journal*, 2015 July; 6(3).

⁷ N. Salamon, "Concierge Medicine and Halacha," *Journal of Halacha and Contemporary Society*, 2009; 58:84–106.

⁸ Other variations on difficult questions of parenthood will not be discussed in this article, such as an *asif*, a child found abandoned in a public place when the identity of neither parent is known. In this case it is unknown whether the parents are legitimate or *mamzerim* (*Kiddushin* 4:12; *Rambam, Issurei Bi'ah* 15:13; *Tur, EH* 4; *Shulhan Arukh, EH* 4:31). A *shetuki* is a child known to be born of an unmarried Jewish mother who either refuses to disclose the identity of the father

Jewish law prohibits a *mamzer* from marrying into the Jewish community. The concept of a *mamzer* is a restriction that poses a significant ethical quandary, since the *mamzer* child is effectively punished for a crime that he or she did not commit.⁹ A recent study estimates that approximately 50 children born in Israel each year are designated as *mamzerim*.¹⁰ The Biblical source for these laws is specified in Deuteronomy 23:3:

A *mamzer* (bastard) shall not be admitted into the congregation of the Lord; none of his descendants, even in the tenth generation, shall be admitted into the congregation of the Lord.

The Mishnah explains and expands upon these laws and states that a *mamzer* is the offspring of any prohibited sexual union that is punished by death or *karet* (being cut off from the Jewish people). Any offspring born from an incestuous union or from a woman legally married to a man other than the father are deemed *mamzerim*. In addition, rabbis prohibit a marriage between a *mamzer* and a Jew. However, marriages between a *mamzer* and a convert or between two *mamzerim* are permitted. Nowadays, the most common reason a person would be classified as a *mamzer* is if a Jewish woman remarries without first obtaining a *get*, a divorce by Jewish law, from a reputable rabbinic organization.

Mamzerut can also rise in the case of an *agunah*. An *agunah* is a woman whose husband refuses to grant her a religious writ of divorce or whose husband is missing without any evidence whether he is alive or deceased. Were such a woman to have a child with another man while still religiously married to her former husband, the child would be considered a *mamzer*.

The Talmud¹¹ explains the term *mamzer* homiletically as consisting of the words *mum* (defect) and *zar* (strange/alien), a euphemism for an illicit union in the person's lineage. The *mamzer* status is hereditary—a child of a *mamzer* (whether mother or father) is also a *mamzer*. However, the child of a male *mamzer* and a gentile mother will be gentile but not a *mamzer*. Thus, after proper conversion to Judaism, this child will acquire the status of a legitimate proselyte and the fact that his father was a *mamzer* will be

or claims not to know it (*Kiddushin* 69a; Rambam, *Yad, Issurei Bi'ah* 15:12). Since the father's status is unknown, the child is likely to be considered a "doubtful" *mamzer* (*Kiddushin* 74a; Rambam, *ibid.*; *Arukh ha-Shulhan, EH* 4:47).

⁹ Discussion of the underlying ways to resolve these ethical quandaries is beyond the scope of this article.

¹⁰ <https://www.timesofisrael.com/father-unknown-a-dread-biblical-status-leads-to-modern-problems/>.

¹¹ *Yeravot* 76b and *Yerushalmi, Kiddushin* 3:12.

halakhically irrelevant.¹² Interestingly, a marriage between two *mamzerim* is permitted but the children are still deemed *mamzerim*.¹³ Additionally, according to *Avot de-Rabbi Natan* a *mamzer* cannot enter Jerusalem.¹⁴

Despite the social challenges that a *mamzer* faces, he is recognized as a full member of the Jewish nation and able to achieve spiritual greatness. “A *mamzer* who is a Torah scholar,” say the sages, “precedes an ignorant High Priest in medical triage.”¹⁵

Rabbis require strict evidentiary standards to establish a *mamzer* status, sufficiently strict that in many cases, the existence of *mamzer* status is hard to develop and generally does not arise. Sometimes, rabbis will deem the married status of a couple as not being halakhically acceptable and thus the subsequent “affair” is not considered as adultery. Another interesting question is whether a woman may abort a *mamzer* fetus. R. Yair Bacharach writes that *le-khathilah* she may not abort the fetus,¹⁶ despite the fact that Maharil writes that at the *brit* of a *mamzer* we do not recite the blessing to “preserve this child to his father and mother,” because we do not want to increase *mamzerim* among the Jewish people.

There are rabbinical scholars¹⁷ who believe that a *mamzer* is halakhically denied the option of fathering a child by a gentile woman. However, if he violated this law, the resulting child would not be considered his progeny and could convert to Judaism and avoid the designation of being a *mamzer*. Another way to avoid a child’s being designated as a *mamzer* is when a *mamzer* fathers a child with a slave girl.¹⁸

¹² *Kiddushin* 67a, 79b; Rashi *ibid.*; 72b–73a; Rambam, *Yad, Issurei Bi’ah* 15:3 and 14:7; *Shulhan Arukh, EH* 4:22, *Tur* and *Beit Yosef, EH* 4; *Shulhan Arukh, EH* 4:20.

¹³ *Yeramot* 45b; *Kiddushin* 69a; 74a; Rambam, *Yad, Issurei Bi’ah* 15:33; *Shulhan Arukh, EH* 4:24.

¹⁴ Chapter 12:8, Solomon Schechter, ed., *Abot de-Rabbi Nathan* (Vienna, 1887) and M. L. Rodkinson in his translation of the Babylonian Talmud (New York, 1900).

¹⁵ Rav Moshe Feinstein states that this law is not practiced today because we cannot judge people this way.

¹⁶ *Responsa Harot Yair* #31.

¹⁷ R. David Katz, 1994, “The *Mamzer* and the *Shifcha*,” *JHCS*.
<https://www.aishdas.org/avodah/faxes/mamzerShifcha.pdf>.

¹⁸ *Ibid* #16. The Mishnah in *Kiddushin* 69a states that *mamzerim* can be purified. How? If a *mamzer* married a slave, the offspring is a slave and may be freed to become a freeman. In this way, the biological offspring are considered as free converts to Judaism without the status of a *mamzer*. This is also the ruling of the *Shulhan Arukh* (*EH* 4:20 and 8:5). While Rambam states the relations with a slave and a free Jew are only permitted *me-d’oraita* (as a Torah law) but are rabbinically prohibited, he allows such a relationship for the purpose of fathering children who are not *mamzerim*. Rambam, *Issurei Bi’ah* 15:4.

Modern assisted reproductive technology, such as IVF, has complicated the issue of *mamzerim* but may offer a way to potentially prevent a child from being designated as a *mamzer*. If a *mamzer* produces a child with his Jewish wife via IVF, will the child still be deemed a *mamzer*? Regarding IVF and procreation, there are two factors that need to be considered. The first relates to establishing the fatherhood status of a child produced via in vitro fertilization. The second is whether producing a child *sine concubito* (without marital relations) violates the prohibition of producing children who are *mamzerim*.

Clearly, there are several examples quoted in the Talmud (i.e., *Hagigah* 14b) that support the idea that producing a child in the absence of marital relations will generate a child whose father is determined by the human source of the semen. While the Rambam expresses his lack of medical understanding how the case in *Hagigah* of a woman entering a bath after a man has left but deposited his seed in the bath can occur biologically, many authorities (including Rabbi Hayyim Joseph David Azulai and Rabbi J. Ettlinger) believe that the semen donor in this case is the father.¹⁹ The second issue is whether the child produced in the absence of marital relations confers the status of a *mamzer*. There are many differing opinions on this matter but some of the great Jewish legal decisors, including Rabbis Weinberger, M. Feinstein, and Shlomo Auerbach, state that the status of the child is **NOT** a *mamzer* because fertilization took place in a test tube and not within the woman's body.

Rabbi Moshe Feinstein²⁰ and Rabbi Auerbach²¹ ruled that if a married woman is inseminated by sperm from another man, the child is not a *mamzer*, since it did not result from a sexual act of adultery. They state that the prohibition of a *mamzer* to have children only pertains to children born via conventional sexual relations. Rav Feinstein provides proof of his ruling from the famous story of Ben Zira. Ben Zira was both the son and grandson of the prophet Jeremiah who was coerced to emit his seed in a bathhouse and then his daughter entered the bath and conceived a boy. In quoting this story, Rabbi Feinstein notes that there is no mention that Jeremiah's son was a *mamzer*.

Rabbi Auerbach rules that it is forbidden to inseminate a woman with sperm from a Jewish donor who is not her husband. However, if this did happen, the woman may continue to live with her husband even if he is a

¹⁹ I. Jakobovits, "Artificial insemination, birth-control and abortion," *Ha-rofe ha-ivri: The Hebrew Medical Journal*, 1953 Jan 1; 2:169–83.

²⁰ R. M. Feinstein, *Iggerot Moshe*, EH 2:11, pp. 322–324.

²¹ R. Shlomo Z. Auerbach, "Artificial Insemination," *Noam* 1 (1958), pp. 145–166.

Kohen. However, the child born from this process would be a **doubtful mamzer**. If no other method is available to help a couple have children, it is permissible to use the sperm from a non-Jewish donor.²² Other rabbis, including Rabbi Joel Teitelbaum, disagreed, and ruled that since the child produced with donor sperm is known to be that of a man other than her husband, the child is a full-fledged *mamzer*.²³

The use of stem cells in an IVF protocol rather than semen provides a potential interesting extension of our discussion on the problem of *mamzerim*. One advantage in using stem cells over donated semen is that the gametes were not produced in the testes and the cells were not derived from sperm. The cells were generated in a laboratory and may not be considered as semen or sperm (*zeraḥ*) from a halakhic perspective.

There are two methods that can be employed to generate a fetus via stem cells. First, an adult cell is removed from the skin cells of a man and is fused with a woman's egg whose nucleus (containing all the chromosomes) has been removed. In this cloning-like method, the adult cell obtained from the man provides most (excluding the mitochondrial DNA) of the genetic instructions to form the fetus and child. Second, stem cells from the man can be transformed into a gamete-like cell containing only 23 chromosomes and fused with an egg obtained from his partner.

It is important to understand that many sexual prohibitions in halakhah include the term *zeraḥ* within the prohibition. Gamete-like stem cells would probably not be considered as *zeraḥ* since they were not derived from semen. In addition, the procurement of semen from a Jewish man presents halakhic concerns such as *shefikhat zeraḥ* (spilling semen in vain),²⁴ a halakhic concern that will not apply when obtaining stem cells from skin or blood. The only halakhic issue that may emerge is the law of *havalah* (the prohibition of causing a wound in the body) because the stem cells must be obtained from either blood or skin. Yet, there are many examples where the prohibition of *havalah* does not apply, especially when using medical treatments to produce healthy children.

One could speculate that, according to Rabbi M. Feinstein, using stem cells from the infertile husband would clearly be as good as, or even better

²² A. Steinberg, "Medical-Halachic Decisions of Rabbi Shlomo Zalman Auerbach" (1910–1995), *Jewish Medical Ethics*, 1997 Jan 1; 3(1):30–43.

²³ Yoel Jakobovits, (2005), "Assisted Reproduction through the Prism of Jewish Law" (PDF) *Jewish Action*, 65 (3): 26–29.

²⁴ Some *poskim* rule that *zera le-vatalah* is a Biblical prohibition, and some even list it as part of the 265 negative commands. Other *poskim*, however, understand that it is not a Biblical prohibition, but rather rabbinic. See *Torat Hesed* 2:43; *Iggerot Kodesh* 9:25; 11:420 and 275; *Encyclopedia Hilkhatit*; *Otzar Ha-Poskim* E.H. 23.

than, using donor semen for a *mamzer* to have non-*mamzer* children. This is because the stem cells come from the husband and not from another man. However, Rav Eliezer Waldenberg²⁵ argues that in the case of a husband and wife where the child is conceived via IVF, the husband is not considered to be the child's halakhic father. Similarly, Rabbi Waldenberg might rule in our case of using stem cells to generate a child, that the husband should not be the halakhic father. Since this child is produced from the stem cells of the *mamzer* man, Rav Waldenberg might rule that a "fatherless" child of a *mamzer* **would not** be a *mamzer*.

The Meiri, in his commentary to *Sanhedrin* 67b, writes that breeding creatures asexually is permitted, because asexual reproduction is a function of the natural world and anything performed naturally is not defined as a prohibited act of *kishuf* (sorcery). What does Meiri mean in his term "asexual"? If Meiri defines asexual as the absence of marital relationship, then we could assume that according to Meiri, halakhah would allow a child to be produced using stem cells and IVF. It is remarkable that Meiri understood human reproduction in his suggestion that it may be possible to produce human beings asexually.

It is also clear from the Talmud and our rabbinical sages that efforts have been made to prevent people from being declared *mamzerim*. Our rabbis always try to seek and resolve every case of *mamzerut* with dignity.²⁶ For example, a *mamzer* may marry a gentile slave who then converts to avoid having children who are *mamzerim*. Specifically, Rabbi Tarfon's advice to a *mamzer* is to marry a *Shifshah Kena'anit* as he will not be regarded as the halakhic father to their child.²⁷ Indeed, Rabbi Tarfon's ruling is codified in the *Shulhan Arukh* as normative halakhah.²⁸ Another clever halakhic resolution is proposed in a case where a woman thought that her husband had passed away while traveling abroad and was given the right by the local *beit din* to remarry and have children. Years later, the husband suddenly appears and actualizes a situation that may render the child of the woman's second marriage a *mamzer*. To avoid deeming this child a *mamzer*, the Talmud provides an interesting solution. The first "husband" should write the divorce *get*, but not hand it to her directly. Rather, he should throw it in her vicinity but not within four cubits of her person. The Talmud states that the act of throwing the *get* to the woman does not follow the precept status in the marital ceremony by the husband stating

²⁵ *Tzitz Eliezer* 15:40.

²⁶ <https://moderntoraleadership.wordpress.com/2019/09/20/why-didnt-the-rabbis-eliminate-mamzerut-part-2/>.

²⁷ Ibid. #16 and *Kiddushin* 69a.

²⁸ Ibid. #16.

under the chupah “by this ring you are consecrated to me according to the law of Moses and Israel.” The husband is thus committing his life to be consecrated to this woman according to the moral laws of Moses. The Talmud then states that a person who throws the *get* at his wife is not following the moral law of Moses and, therefore, his marriage can be retroactively annulled. In this manner the woman’s first marriage to the man who allegedly “died” never existed in the eyes of Jewish law and her marriage to the second man is valid and her children would not be *mamzerim*. It is clear from these Talmudic discussions, that efforts should be made by rabbis to avoid declaring a child as a *mamzer*. In this vein, one could then speculate that employing IVF with donated sperm or using stem cells might provide another halakhically appropriate way to prevent children from being deemed *mamzerim*.

When considering the use of stem cells as gametes, it is important to understand a famous Talmudic statement in *Niddah* (30b) which states that there are three partners involved in producing a child: the father, the mother, and God. While the Talmud specifies how each partner contributes various essential components of the human body, it never specifies what cells the father or mother contribute to the creation of the child. Maybe stem cells or sperm or eggs would be equally valid forms of cell contribution to producing a child. Furthermore, *Adam Ha-Rishon* and *Hayah* were created by God without sperm or eggs and are considered human as stated in the Bible “and God called them “*adam*.²⁹ Thus, we have a *remez* from the Torah that sperm or eggs are not halakhically necessary to create viable human embryos.

Future Halakhic Applications of Stem Cell Technology

A Kohen is not allowed to marry a divorced woman, a convert, or a woman who has had relations with a non-Jew—and if they do, their children and the husband are considered as *halalim*, i.e., “defective” Kohanim. In addition, the rabbinical decree states that this Kohen is also prohibited from marrying a woman who is prohibited to the priesthood. A *halal* today loses the rights of honor that a Kohen has, such as blessing the congregation, exemption from *pidyon haben* (the obligation to redeem his firstborn son), and receiving the first *aliyah* when being called up to the Torah. In addition, the daughters of a *halal* are not allowed to marry Kohanim. Other *Kohanit* law such as serving in the Temple and eating *Terumah*

²⁹ J. D. Loike and M. D. Tendler, “Halakhic Definition of Homo Sapiens,” *Tradition*, 37:2 p. 1–19, 2003, PMID: 15468502; J. D. Loike, I. Bedzow, and M. D. Tendler, “Halakhic Issues Related to Synthetic Biology,” *Hakirah*, Vol. 30, Spring 2021.

and *Kodshim* do not apply today since our Temple has not been rebuilt.

As with a *mamzer*, the *halal* child did nothing wrong and yet is punished for acts of his parents. Should rabbinical decisors propose solutions for a *halal* to have “normal” children as they do for *mamzerim*? A potential solution that rabbis may consider is whether a *halal* man can use stem cells and IVF to produce a child who would not be deemed as a *halal*? As with the case of a *mamzer*, using stem cell technology and IVF may circumvent the “*halal*” status of the child of a Kohen who marries a divorcée. However, it remains to be established by our current rabbis whether the male child will retain his *Kehunah* status. One could propose that since his grandfather was a legitimate Kohen, the child might retain a Kohen state. Our current rabbinical scholars should consider whether the daughter produced from a *halal* father via stem cells and IVF could, in fact, marry a Kohen.

Is There an Issue of *Mar’it Ayin* in the Case of a *Mamzer*?

If the rabbis would allow IVF and stem cells to be used by a *mamzer* to have legitimate non-*mamzer* offspring, a question arises as to whether there would be an issue of *mar’it ayin* (“appearance to the eye”) as the prohibition against giving the impression that one is doing something wrong when it may influence others to sin as well? One has a responsibility to avoid even the appearance of halakhic prohibition. As it says in Proverbs 4:24: “Remove from yourself an untrue mouth, and distance yourself from crooked lips.”³⁰

There are several marital situations where *mar’it ayin* plays a role. One case is a widow who utilizes IVF to produce a child. Rav Shlomo Zalman Auerbach³¹ strongly objects to a single woman conceiving a child by means of artificial insemination. A second case involves gender selection by an infertile couple where the husband is a Kohen and the wife is Jewish. If this couple uses sperm donation from a non-Jew and IVF, can the husband choose to select a female embryo for implantation into his wife so that no one will know that “their” child was produced via sperm donation?³² Many rabbinical scholars, such as Rabbi S. Auerbach, generally oppose sex selection for family balancing.³³ Clearly, if this man had a male child, the father would receive the Kohen *aliyah* while his son would not.

³⁰ *Nishmat Avraham* IV, p. 181.

³¹ *Nishmat Avraham* IV: EH 1:3.

³² J. B. Wolowelsky and R. V. Grazi (2007), “Sex Selection and Halachic Ethics: A Contemporary Discussion,” *Tradition* 40:1.

³³ *Ibid.* #35.

This “Kohen father” would be concerned that every member of his community would thereby know his legal child was not his genetic son, destroying his privacy in this manner. In fact, Rabbi Aaron Lichtenstein, *zt”l*, the former Rosh Yeshivah of Yeshivat Har Etzion, has written that in the case of a Kohen, sex selection should be permissible.³⁴ Thus, our rabbis might even consider rendering a stem cell-generated child from a *mamzer* as a legitimate method to generate non-*mamzer* children.

Conclusions

In this article, we propose that our rabbinic scholars consider the merits of using stem cell technology and IVF as a way to prevent children of a *mamzer* to be deemed *mamzerim*. Clearly, it is critical that our rabbinic community review the scientific literature about the use of stem cells in creating a gamete-like cell for procreation; only then can they rule on the use of stem cells and IVF to allow a *mamzer* to have non-*mamzer* children.

These types of technologically based halakhic discussions underscore the fact that our halakhic processes are very open to the incorporation of scientific breakthroughs to help mitigate or resolve halakhic problems. Scientific discoveries alone may not be sufficient to modify or codify halakhah but can serve as an asset in determining halakhah. We immediately think about the Shabbos elevator, the Shabbos clock, parve milk, the re-discovery of *tekhelet*, defining death, and organ donations as scientific breakthroughs that have impacted how rabbis direct us to observe mitzvot. The potential incorporation of science within the scope of halakhah is based on the fact that science is essentially the study of G-d’s work.

In his *Guide for the Perplexed*, Rambam suggests the following approach to the acquisition of knowledge: a man must study the rules of logic, geometry, arithmetic, philosophy, and the natural sciences; only one who is well versed in the above-mentioned sciences will be equipped to properly interpret the Holy Scriptures and rule on halakhic decisions. He also states that the study of science is one of the routes that enables a person to love and fear (or be in awe of) God. This Maimonidean principle is emphasized twice a day in *berakhot* before *Shema* (*Ma’ariv Aravim* in the evening and *le-Kel Barukh* in the morning).

The Lubavitcher Rebbe states that “All that G-d did was for His sake”—all that G-d created in His world was created solely for the service of holiness. “Science” is one of G-d’s creations that receives its vitality from the Torah. ☰

³⁴ R. V. Grazi and J. B. Wolowelsky, “Addressing the idiosyncratic needs of Orthodox Jewish couples requesting sex selection by preimplantation genetic diagnosis (PGD),” *Journal of Assisted Reproduction and Genetics*, 2006 Nov.–Dec. 23: 421–5.