

1. R' Dr. J. David Bleich, *Mitochondrial DNA Replacement: How Many Mothers?*, Tradition 48:4 (2015)

Mitochondria are bean-shaped organelles present in every cell of the human body. Mitochondria are analogous to batteries in the sense that they power the cells of all complex life-forms by converting glucose into energy. Cessation of respiration cuts off oxygen from the mitochondria. Lack of oxygen prevents the mitochondria from converting nutrients into energy. Lack of energy, in turn, causes the cells to cease functioning and leads to the end result – death.

Mitochondria are present in the cytoplasm of the female ovum and are passed on from mother to child. Mitochondria contain their own DNA. Thirty-seven genes are present in the mitochondrial DNA (mtDNA) passed directly from a woman's ovum into every cell of her progeny...

Total mitochondria replacement results in an embryo having mitochondrial DNA derived entirely from the donor while the nuclear DNA is entirely that of the recipient mother and the male from whom the sperm has been obtained. Fertilization of manipulated ova resulted in manifestation of many genetic abnormalities but seemingly normal embryonic stem cell lines could be extracted in a significant percentage of ova fertilized by that method.

2. US FDA, *Advisory on Legal Restrictions on the Use of Mitochondrial Replacement Techniques*, fda.gov 3/16/18

Mitochondrial Replacement Technology (MRT) using donor mitochondria represents a possible treatment for mitochondrial disorders, but introduces a genetic modification and raises safety concerns. The clinical use of MRT in the United States falls within FDA's regulatory authority. Since December 2015, Congress has included provisions in annual federal appropriations laws that prohibit FDA from accepting applications for clinical research using MRT. Therefore, clinical research using MRT in humans cannot legally proceed in the United States.

3. Government of Canada, *Prohibitions related to scientific research and clinical applications*, canada.ca 1/09/14

Under section 5(1) and section 9 of the AHR Act, no person shall knowingly:...

(f) alter the genome of a cell of a human being or in vitro embryo such that the alteration is capable of being transmitted to descendants;...

Because the definition of "genome" in the AHR Act includes all the genetic information in a cell, this prohibition also prevents the use of technologies intended to replace defective mitochondrial DNA in a woman's eggs.

4. *Mitochondrial manipulation in fertility clinics: Regulation and responsibility*, Reprod Biomed Soc Online '18 Apr; 5

With regard to germline genetic modification for reproduction, Israeli Law 2016, which is effective until 2020, prohibits the clinical use of 'reproductive cells that have undergone a permanent intentional genetic modification'. However, male embryo transfer following MMT (mitochondrial manipulation techniques) does not fall under 'a permanent intentional genetic modification' because mtDNA is only maternally inherited in children.

5. R' Dr. J. David Bleich, *Mitochondrial DNA Replacement: How Many Mothers?*, Tradition 48:4 (2015)

A negative assessment of the propriety of mtDNA replacement does not obviate the need for a determination of maternal identity *post factum*. That which is possible in the physical universe tends to become actual, at least sporadically. "In technology, whatever can be done, will be done," regardless of moral reservations on the part of some. A *fait accompli*, even if immoral in inception, poses halakhic questions that, even if unwelcome, must be answered.

6. Our question: Sarah's DNA is merged with Rebecca's mitochondria and implanted in Rachel's uterus.

7. The Artificial Uterus <https://www.yutorah.org/lectures/lecture.cfm/918137/>

Defining the options

8. Rabbi Asher Weiss, <https://en.tvunah.org/2013/12/29/triple-parent-ivf/>

In truth, the main force of my argument comes from what seems clear and obvious in my eyes, that it is halachically impossible to have two mothers, just as one cannot have two fathers. If it is this one, it is not that one...

9. R' Dr. J. David Bleich, *Mitochondrial DNA Replacement: How Many Mothers?*, Tradition 48:4 (2015)
The Gemara states: "And a champion [*ish ha-beinayim*] . . . went out from the camp of the Philistines" (I Samuel 17:23).
What is the meaning of "*beinayim*"? . . . R. Yohanan said, "He was the son of a hundred fathers and one mother." . . .
According to *Tosafot*, Goliath's paternity was not a matter of speculation or indeterminacy: his father, or better, his fathers, were readily identifiable. Each of his mother's consorts was quite literally his father...
Footnote: *Tosafot's* analysis, even if rejected as empirically incorrect, is significant because it reflects *Tosafot's* willingness to entertain halakhic recognition of two fathers.

10. Yes it can <https://www.cnn.com/2019/02/28/health/rare-twins-semi-identical-australia-trnd/index.html>

11. Rabbi Moshe Sternbuch, *Teshuvot v'Hanhagot* 5:318

In my humble opinion, one could contend that since the two women cause the formation and development of the child in the end, and one cannot have one without the other, there is room to say that both have the status of "mother" and the child has two mothers. Similarly, we find in *Tosafot Sotah* 42b that a child could have two fathers.

12. R' Dr. J. David Bleich, *In Vitro Fertilization: Questions of Maternal Identity and Conversion*, Tradition 25:4 (1991)
R. Eliezer Waldenberg, *Ziz Eli'ezer*, XV, no. 45,5 has advanced the novel view that, in the eyes of Halakhah, a child born of in vitro fertilization has neither a father nor a mother even if the biological mother and the gestational mother are one and the same, as is the case in the majority of instances in which in vitro procedures are employed. Rabbi Waldenberg's arguments, which are not based upon cited precedents or analogy to other halakhic provisions, are three in number: 1) Fertilization in the course of an in vitro procedure occurs in an "unnatural" manner through the intermediacy of a "third power" extraneous to the father or mother, i.e., the petri dish....

To this writer, those arguments appear to be without substance. In response to the first argument it must be stated that the petri dish is not a "third power" and in no way contributes biologically or chemically to the fertilization process. It is simply a convenient receptacle designed to provide a hospitable environment in which fertilization may occur.

Three Models of Pregnancy

13. Rabbi Ezra Bick, *Ovum Donations: A Rabbinic Conceptual Model of Maternity*, Tradition 28:1 (1993)

There is, however, no clear source in rabbinic literature which suggests that a woman has ova. Inasmuch as the rabbis certainly had a concept of motherhood, such a concept must be definable without reference to the ovum. This in and of itself might argue for birth as the sole determining factor for motherhood.

However, there is another conceptual model of parenthood, one based on the model of fertilization rather than donation and combination. This model perceives the role of father and mother as essentially parallel to what takes place in agriculture, where a seed is placed in a fertile environment.

14. Pamela Laufer-Ukeles, *GESTATION: WORK FOR HIRE OR THE ESSENCE OF MOTHERHOOD?*, Duke Journal of Gender Law and Policy, 9 (2002)

The majority opinion in Jewish law is that gestation is the defining characteristic of motherhood. Defining motherhood by that which is unique to mothers, as discussed by Rabbi Engel, and more explicitly by Rabbi Bick, is based on the Jewish law recognition of differences between men and women.

15. Talmud, *Yevamot* 97b

If twin brothers convert or are freed from servitude... one would not be liable for relations with his brother's wife. If they were conceived before their mother became Jewish but they were born once their mother was Jewish... one would be liable for relations with his brother's wife.

16. Talmud, *Megilah* 13a

"For she had neither father nor mother, and when her father and mother died" – Why all of this [text]? Rav Acha said: Upon conception her father died, and upon birth her mother died.

17. Targum Yonatan to Bereishit 30:21

And Gd heard the prayers of Leah, and the fetuses were switched in their wombs, and Joseph was placed into the womb of Rachel, and Dinah into the womb of Leah.

18. R' Dr. J. David Bleich, *In Vitro Fertilization: Questions of Maternal Identity and Conversion*, Tradition 25:4 (1991)
Although there is a minority view that regards the donor mother as the sole mother of a child born of in vitro fertilization, the consensus of rabbinic opinion is that a maternal-filial relationship is generated between the gestational mother and the child, despite the absence of any genetic relationship, by virtue of parturition alone. Whether or not the genetic mother, i.e., the woman who produced the ovum from which the child was conceived, is also a mother from the vantage point of Jewish law is a more complex question. The question of whether the baby may, in effect, have two halakhic mothers must be regarded as yet open.

19. Talmud, Niddah 31a

There are three partners in a person: Gd, his father and his mother...

20. Rabbi Itamar Warhaftig, *קביעת אמהות*, Techumin V

It appears logical to me that a parent from whom an egg is taken is more likely to be considered the mother. The child is born from a blend of the father's seed and the mother's egg, and they impact his traits – see Niddah 31a... The fetal development in the womb of the mother is only the place where it grows. Today, part of this process can be done in a laboratory. Even if we will say that the contribution of a mother developing it in her womb is better than that of a laboratory, still, it would only be adding to the seed which has been formed in conception.

Egg from one mother, Mitochondria from another mother?

21. Rabbi Asher Weiss, <https://en.tvunah.org/2013/12/29/triple-parent-ivf/>

Still, it appears that in our case, when the great majority of the genetic material is found in the nucleus of the Jewish mother's egg, and only about 1/1000 of it is found in the portion taken from the non-Jewish donor, it is certainly logical to follow the majority and the essence, and the child is Jewish for all purposes...

Although there is room to argue and say that if we would truly compare cases, then regarding nullification in the majority we say that an ingredient which supports the whole is not nullified, and further, that which provides taste is not nullified...

In truth, the main force of my argument comes from what seems clear and obvious in my eyes, that it is halachically impossible to have two mothers, just as one cannot have two fathers. If it is this one, it is not that one...

22. R' Dr. Avraham Steinberg, Special Session at the 2019 Convention of the RCA, minutes 31-32

...[T]he mitochondria, the function of the mitochondria is to supply energy to the cell, to function. It has nothing to do with the DNA that creates the human being, that is part of the creation of the human being... Would we say that if someone gets a heart transplant, the donor is his father?... [P]arenthood goes only by the DNA that has to do with the creation of the human being...

23. R' Dr. J. David Bleich, *Mitochondrial DNA Replacement: How Many Mothers?*, Tradition 48:4 (2015)

Nullification in the nature of *bittul be-rov* expresses the concept that, in a mixture, the identity of the lesser quantity of material is suppressed and hence submerged in the identity of the major component. That principle does not apply in situations in which the lesser component remains readily discernible in the composite mixture. Genes that govern determination of physical characteristics would seem to be of that nature....

Those genes do not necessarily manifest themselves in discernible physical characteristics. Nevertheless, such genes seem to be analogous to a *davar ha-ma'amid* that is not subject to nullification. An emulsifier is an example of a *davar ha-ma'amid*. A *davar ha-ma'amid*, literally, "a substance that holds up" or stabilizes other substances, is not subject to nullification because, although it is itself not directly seen in the compound, a discerning observer can perceive its effect and hence its identity cannot be regarded as having been suppressed. Arguably, genes that preserve physical or physiological integrity "stabilize" the health of offspring with the result that those genes should be regarded as perceivable in the functioning of a normal, healthy human body...