Who Wears the Genes: Hemophilia in the Gemara

by Aviva Sussman

Genetics is often associated with modern biology, as this science was started about a 150 years ago by Gregor Mendel. Known as the father of modern genetics, Mendel is noted as the first to understand how genes segregate during gamete formation. He performed experiments with garden pea plants, crossing different purebred strains and their progeny. Mendel observed the crosses for several generations and concluded that traits were controlled by factors which we now call genes.¹

Looking back into Jewish tradition, however, one can see that although the term genetics had not yet been coined, a complex pattern of inheritance concerning genes was recognized at least as far back as Biblical times. In Bereshit, Parshat VaYetzei, Jacob requested that Laban give him all of his pure white sheep and pure black goats. Jacob’s intention was to breed the animals and give Laban any pure colored, or monochrome, offspring, while he would keep only the spotted offspring. Laban assumed that most of the offspring would be monochrome. Thus, Jacob would only acquire the small amount that was born spotted.

Surprisingly, after breeding the livestock for several generations, Jacob attained quite a large flock of speckled animals. Y. Feliks, author of Nature and Man in the Bible, proposed, “from the Biblical passage [Bereshit 31:12] it emerges that the laws of heredity were revealed to Jacob when the angel of G-d, appearing to him, opened his eyes to a comprehension of the subject.” Feliks suggests that although all of the animals that Jacob originally acquired were monochrome in their phenotype, their genotypic constitution was either heterozygotic or homozygotic. The heterozygotic animals, or hybrids, exhibited a condition called hybrid vigor, or heterosis, in which the hybrid has more potency (i.e., is stronger) and was able to conceive before the purebred. It was through Jacob’s understanding of the laws of heredity that he was able to increase his flocks of spotted sheep and goats.²

The laws of heredity that Jacob used to increase his flock apply to those genes located on the chromosomes known as autosomes. Human beings possess 23 different pairs of chromosomes. One chromosome from each pair is inherited paternally, and the other is maternally inherited. Humans possess 22 pairs of autosomes, which are common to both of the sexes. One pair of chromosomes differs between the sexes. These are the sex chromosomes. Human females have two X chromosomes — a matched pair, while males have one X and one Y chromosome — an unmatched pair.³

When looking at gene control in autosomes, we see that each type of gene is present in duplicate (one gene on each chromosome of a pair). While both genes are present, different allelic forms of the same gene exist. It is possible that one will exhibit stronger phenotypic expression than the other allelic form. This gene is called the dominant gene. In contrast, a recessive allele is that form of a gene that is not expressed when in the presence of its dominant allelic form. If there are two dominant genes present, the dominant trait will be expressed. If there is one dominant and one recessive allelic form of the gene, then the dominant gene will phenotypically be expressed, but the person will be what is called a “carrier” of the other allelic form of the gene. Offspring that inherit two of the recessive alleles will express the recessive phenotypic trait.³

Even more complex than the basic laws of heredity, are those governing the genes located on the sex chromosomes. In terms of dominance and recessiveness, the sex chromosomes in a human female function much as the autosomes. The genes on the X chromosome are dissimilar from those on the Y chromosome, which itself carries very few genes. Thus, in a male, any gene on the X chromosome will be expressed, even if it is not recessive. Traits controlled by genes on the X chromosome are called sex-linked or X-linked traits. Therefore, a human female may be a carrier of a recessive X-linked disease, yet will be free of the disease, while a human male can not be a carrier and will express the disease even if he inherits only one copy of the recessive gene.³

Hemophilia is an example of a disease that is X-linked.

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This condition, in which the blood lacks a certain protein cofactor, results in the blood not clotting normally upon causal to bleed. A female carrier for hemophilia may pass the disease to her son. Because males can never carry the gene on a Y chromosome, it is impossible for them to pass this disease to their sons. Amazingly, it appears that the composers of the Babylonian Talmud had an understanding of this sex-linked trait.

This can be seen from Tractate Yevamot (64b):

For it was taught: If she circumcised her first child and he died, and a second one who also died, she must not circumcise her third child; so Rabbi R. Simeon b. Gamaliel, however, said: She circumcises her third, but must not circumcise her fourth child...Come and hear what R. Hyya b. Abba stated in the name of R. Johanan: It once happened with four sisters at Sepphoris that when the first had circumcised her child he died; when the second [circumcised her child] he also died, and when the third [circumcised her child] he also died. The fourth came before R. Simeon b. Gamaliel who told her, “you must not circumcise [the child].” But is it not possible that if the third sister had come he would also have told her the same? If so, what could have been the purpose of the evidence of R. Hyya b. Abba... It is possible that he meant to teach us the following: That sisters also establish a presumption.

Interestingly, children from the same mother (possibly having different fathers), and cousins whose mothers are sisters are discussed here. No mention of children from the same father (who may have different mothers) or children of brothers are mentioned. In fact, the role of the father in transmission of the disease does not appear to be an issue. Although there is disagreement as to how many prior babies must die of circuncisinal bleeding before exempting the present baby from the brit milah, there is agreement that the cause of death is from a disease that was inherited from the mother. Discussed in Tractate Shabbat (134a) are two specific cases regarding brit milah, in which both of the older brothers of the child in question died after circumcision:

For it was taught in a Baraita: R. Nassan said: Once I went to visit the sea towns, and a woman came before me who had circumcised her first son and he died, her second son and he died, and she brought her third son before me, seeking guidance. I saw that [the infant] was red, and I told [the woman]: “Wait for him until his blood is absorbed into [his flesh],” and then she circumcised him, and he lived. And they called [the child] Nassan the Babylonian after me.

The same Gemara continues:

On another occasion I traveled to the province of Cappadocia, and one woman came before me who had circumcised her first son and he died, her second son, and he died, and now she brought her third son before me seeking guidance. I saw that [the infant] was yellow. I looked closely at him, and I did not see in him any covenantal blood. I then said to [the mother]: “Wait for him until he is full blooded, and then circumcise your son.” And she waited for him until he became full blooded, and then she circumcised him, and he lived. And the called his name Nassan the Babylonian after me.

Although the majority of rabbinical sources agree that the condition discussed in this passage of Gemara is hemophilia, there are differing opinions. Translators have given other names to this condition, such as neonatal thrombocytopenic purpura, newborn erythema, jaundice, and neonatal anemia.

Whether this Gemara refers to hemophilia or to any other condition that jeopardizes a child’s life upon circumcision, it was unanimously agreed either that a brit milah should be postponed until the child is well enough to undergo the procedure or that it should not be performed at all, depending on the severity of the condition.

With modern technology, a laser beam procedure has been developed which would allow a hemophiliac to undergo circumcision without endangering his life. Dr. Shlomo Walfisch has been carrying out such laser circumcisions in Israel for the past ten years. Most recently, he performed the operation on a two-month old infant suffering from hemophilia.

The question arises as to whether circumcision by laser is considered halachically suitable. S. and Y. Walfisch explored this issue by evaluating the criteria needed for a
brit milah to be considered acceptable by Jewish law. Their sources included the Rambam’s Mishneh Torah and the Minchat Yitzchak. Their conclusion was that healthy children, who would not be at risk for a traditional brit milah with a knife, should not be circumcised with a laser. However, when there is danger posed to the child, such as a blood coagulating disorder, laser circumcision may be permissible. Nevertheless, they have noted that this is not meant to be a halachic psak and is an issue that is up for debate.15

Unarguably, Mendel’s experiments with pea plants set the modern study of genetics into motion. Since then, a great wealth of knowledge in this field has been uncovered, leading to numerous discoveries and advances in biotechnology. Sometimes however, we attribute our findings solely to ourselves. We forget that the answers were always there, but without the help of G-d they could not have been found. Because our ancestors acknowledged this, they were successful in understanding phenomenon that would not be understood by the general population until centuries later. The knew that truly, “there is nothing new under the sun.” DH

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Notes: