

By: Stefano/2008, Science Editor

## How Will Your Child Look Like?

### *Some heredity clues*

Kids look like their parents or grandparents, and brothers and sisters look alike. How can you predict the traits of your future child? This is the science of heredity. Heredity operates on genes (made of DNA) placed on chromosomes, located inside a cell's nucleus. Each human has 46 chromosomes, arranged in 23 pairs, half coming from the mother and half from the father. The chromosomes of a pair are similar but not identical. Women have 23 identical pairs (their sexual chromosomes are similar, XX), while men have a pair of different sexual chromosomes: an X and a Y, a hook-like chromosome. Each pair of chromosomes contains similar genes, thus genes appear in pair. Inside a pair of genes, if different, one can be dominant and the other recessive. The dominant gene will manifest in the body of the individual even when in one exemplar (coming from just one parent), while the recessive genes must be present in double set to manifest themselves. For example, the gene for kinky hair is dominant. The genes transmission is aleatory, but this means that, if one parent has kinky hair and the other one straight hair, there is a chance of 50 % (if the kinky haired parent has one gene for kinky hair) or 100 % (if the kinky haired parent has a double set of the gene) for the children to have kinky hair, but none if both parents are straight haired. Not always the "normal" trait is dominant: the polydactyl (extra digits) is caused by a dominant gene. It clearly appears that inbreeding or consanguinity (marriage between close relatives, like first degree cousins) increases the risk for negative mutations to appear in double sets and manifest in children. This explains why 50 % of the Bedouins in the Sinai Peninsula are born deaf! But the genes located on the sex chromosomes act differently. Not all of these genes are linked to sexual traits. For example, the X chromosome harbors a gene for polychromatic vision (enabling us to distinguish green and red) but one of its variations (mutations) is not functional, causing color blindness. The mutation is recessive, but, if a man receives it with his X chromosome, the gene will manifest (as there's no other X chromosome with a dominant normal gene). In women, an individual must have the extraordinarily rare bad luck to inherit two mutated variants of the gene to suffer of color blindness. Thus, the boy can receive the disease only from his mother. Because the color blind man transmits to his son only his Y chromosome, he cannot pass color blindness to his son, but he will transmit the gene (but not the disease, if the mother does not contribute) to his daughter. Similarly the gene causing normal clotting and its recessive mutant causing hemophilia act, genes also placed on the X chromosome. But how do mutations appear? Some may be error of DNA copying during the millions of times of cell division. Just a small change in the chemical pattern of DNA alters the encoded message, and the effect can be from neuter to slightly or severely negative or positive. If the modified gene survives and is transmitted, a new mutation enters the gene pool. Usually, negative changes are eliminated, as the child die before or after birth, or the individual is impaired. But there are also positive mutations, turning the individuals stronger, so the evolution can select for them. Natural rate of mutagenesis (mutation formation) is extremely low, but some chemicals, X-rays and radiation can boost it. Cancers themselves are nothing more than sudden mutations, and exposure to nuclear wastes is known to induce leukemia (white cell blood cancer) in children. Sometimes, during the sexual cells formation, some chromosomes can get extra portion(s) from its partner, lose portion(s), lack at all or be present in double quantity. This causes severe genetic conditions, like the Down syndrome, in which the individual has 47 chromosomes (one extra 21 chromosome). The Down syndrome appears in 1:700 newborn children, and its risk of appearance increases with the age of the mother. The condition causes specific "mongoloid" face and more or less severe mental impairment. Genes do not resume playing the dominance-recessiveness game. The penetrance is the degree which some genes manifest their traits to. It can be weak or strong. For example, camptodactyly (permanent flexion of one or both interphalangeal joints of one or more fingers, usually the little finger) is caused by a dominant gene, but its effect can vary from the rigidity of several fingers (complete penetrance) to the rigidity of just one finger (partial penetrance). Some traits, like hemophilia, are caused just by one gene, but others, like height or intelligence coefficient, depend on an array of gene pairs. These traits are called polygenic. Each composing gene has a weak effect impacting the total. Many polygenic traits, like height, weight or skin color, are influenced by the environment.

Quantity and type of food are also important. Sun exposure can modify skin color. Thus, genes and environment interact for determining how you look, function and behave. For example, musical talent is inherited, but it must be boosted in family or social environments, like other gifts (let's say, poetry, sport and so on). This is a list of dominant/recessive human traits (besides those mentioned in the text): Black hair/blond hair Non-red hair/red hair Rough hair/soft hair Normal pigmentation/albinism Brown eyes/blue or green eyes Myopia or presbyopia/normal sight Normal hearing/deafness Thick lips/thin lips Big eyes/small eyes Shortness/tallness Polydactyl, brachydactyl (short digits)/normal digits Normal muscular tonus/muscular dystrophy Hypertension/normal blood pressure Mentally normal/schizophrenia Irritable temper/calm temper Average intelligence/geniality or idiocy Migraines/normal Disease resistance/disease predisposition Swollen colon/normal colon Swollen spleen/normal spleen A or B blood type or Rh positive/O blood type or Rh negative