

Technical note 4

Fertilization, implantation, and development

FERTILIZATION

When a sperm and egg (or ovum) meet, the sperm penetrates the wall of the egg. The genetic material from the sperm and egg unite, and the process of unifying the genetic contents of sperm and egg is called fertilization. The cell thus formed, containing DNA from both sperm and egg, is called a zygote. The mass of cells in the earliest stages after fertilization is also called a conceptus.

The release of an unfertilized egg from a woman's ovary is triggered by a burst of luteinizing hormone, or LH, from the pituitary gland (located near the base of the brain). The released egg migrates from the ovary a short distance through the abdominal cavity and into the oviducts, or Fallopian tubes. The Fallopian tubes lead into the uterus, and are the usual site of fertilization after the sperm have migrated into them from the vagina through the uterus to meet the descending egg. The developing conceptus then continues its descent through the Fallopian tubes into the body of the uterus.

CELL DIVISION

The zygote begins to divide, first into two cells, then into four, then eight, and so on. During the earliest stages of development all the cells are more or less equivalent. Once more than 16 cells are present, however, some distinctions between different types of cells begin to appear. Quite small and difficult to detect at first, these differences become more pronounced as cell division and growth continue, and form the foundation for the later differentiation of tissues and organs.

Different terms are applied to the developing organism as larger numbers of cells accumulate. The process of cell division is called cleavage. When enough cells have accumulated (between 32 and about a hundred), the term morula is used. The following stage, when the cells arrange themselves around a central cavity, is called the blastocyst. About 1 week after fertilization the blastocyst attaches to the uterine wall to continue further development.

IMPLANTATION

Implantation is the term applied to the process by which the conceptus attaches to the wall of the uterus and begins to send fingers of tissue

(chorionic villi) into the wall of the uterus as anchors. These fingers are made up of embryonic cells that manufacture hormones to support pregnancy; they also form the network of supporting tissues that will eventually become the placenta, nourishing the developing embryo, and later fetus.

DEVELOPMENT

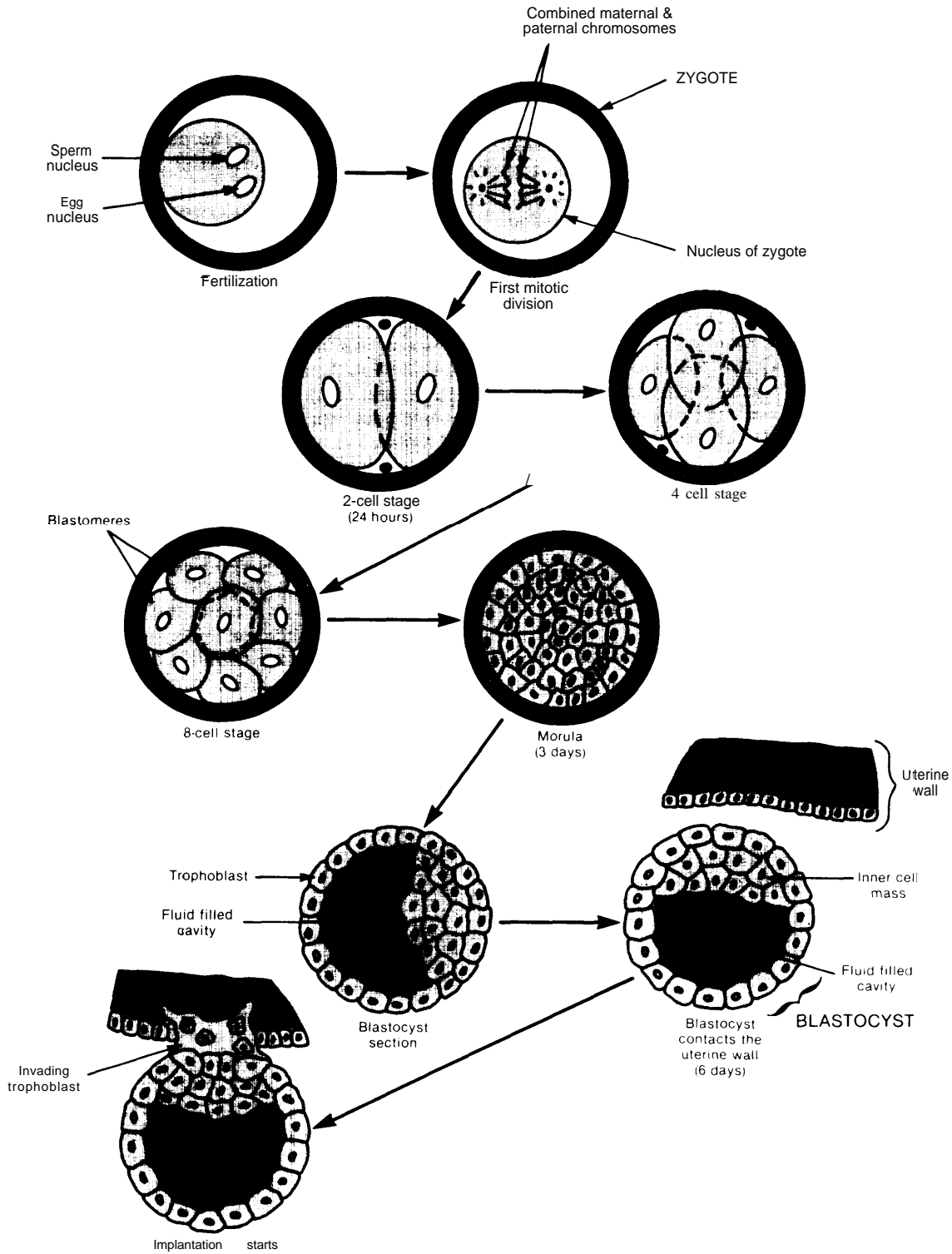
At the same time the primitive placenta is forming, the cells that will later become the embryo, and then fetus, become more distinct from those embryonic cells that develop into the supporting structures (placenta and protective membranes). By 2 weeks post-fertilization the process of implantation is almost complete, and differentiation of the embryo itself is becoming more pronounced: at least two distinct classes of embryonic tissue can be identified. The third week sees the emergence of a group of cells called the primitive streak that will eventually lead to the development of the nervous system, which begins before the end of the third week after fertilization. The primitive streak is the first landmark that distinguishes the "top" from the "bottom" of the embryo.

The embryo rapidly continues to develop more defined features, including limbs, organs, ears and eyes. About 8 weeks after fertilization (7 weeks after implantation) most of the basic tissues have taken shape. It is at this point that the embryo makes the transition to a fetus, with most subsequent development taking the form of growth and specialization of organ function, rather than the formation of new organs. Highly complex systems, like the brain and nervous system, continue to develop long after the embryo has become a fetus, and even after birth.

VIABILITY

Viability is the term used to indicate that the fetus could survive outside the womb. The concept of viability played a central role in the Supreme Court decision in *Roe v. Wade*, in which maternal rights with respect to abortion were decided. The point at which viability begins has been considered to be about the beginning of the third trimester of normal gestation. This is subject to change, however, with innovation and progress in postnatal care. New techniques are proving to be efficient at preserving the lives of younger and smaller premature infants, and the trend promises to continue. The effect of these changes on the medical determination of fetal viability and its relation to maternal legal rights is not at all clear.

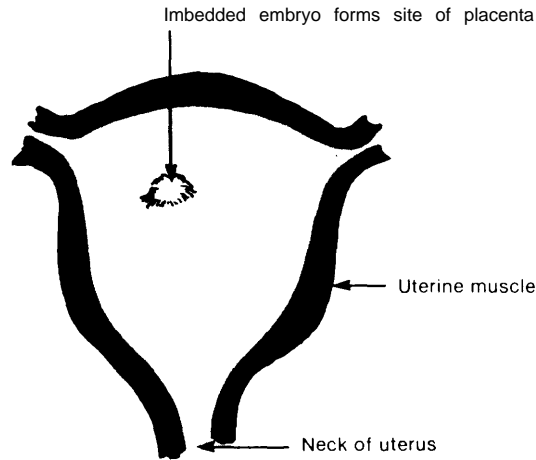
Human Fertilization and Early Embryonic Development



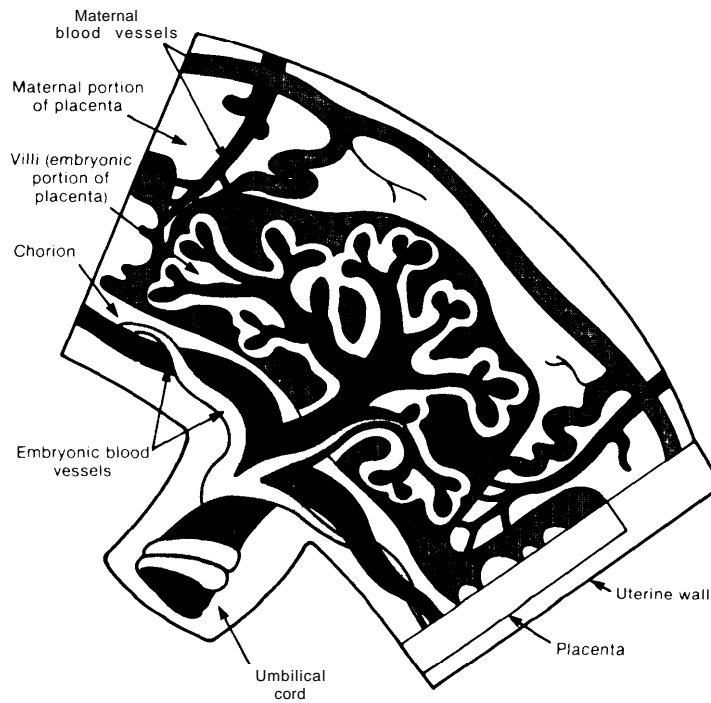
SOURCE: Office of Technology Assessment

Implantation of the Embryo in the Wall of the Uterus

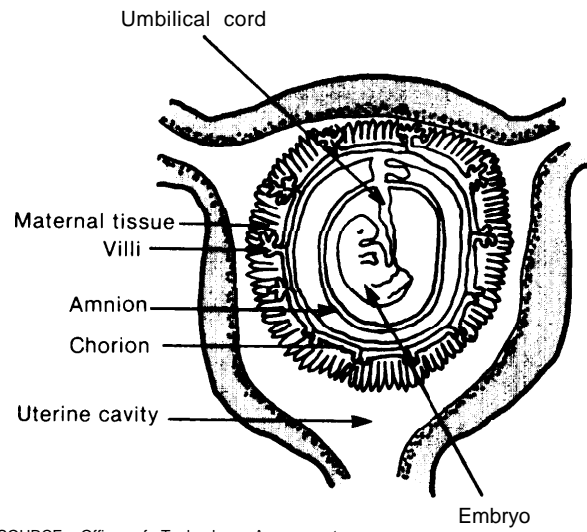
Vertical section: Human embryo, on about the 10th day, becomes embedded in the soft uterine wall. After about 2 additional weeks, the embryo will derive nourishment through a new placenta which will develop at the site of the attachment



Human Placenta

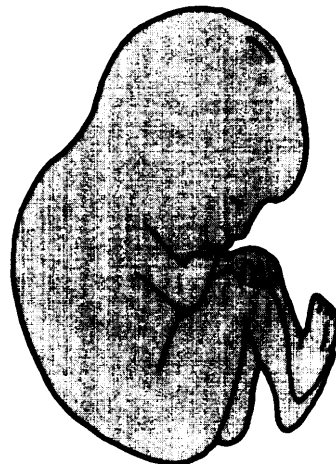
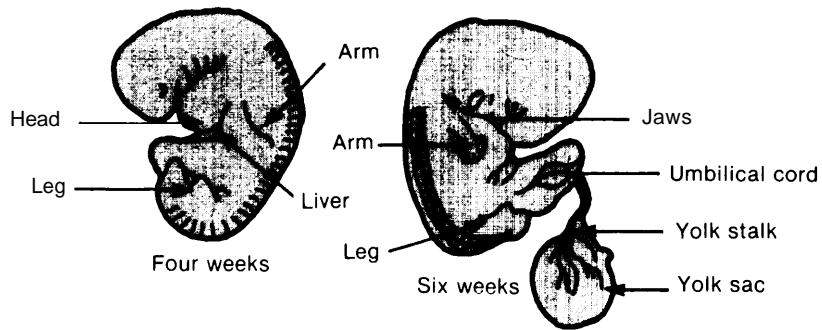


Fetal Position in the Uterus



SOURCE: Office of Technology Assessment.

Human Embryonic and Fetal Stages



15 weeks

SOURCE: Office of Technology Assessment.