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QUESTION

Write a short note on implantation

ANSWER

Implantation is a process in which a developing embryo, moving as a ***blastocys****t*through a[***uterus***](https://embryo.asu.edu/search?text=uterus)***,***makes contact with the uterine wall and remains attached to it until birth. The lining of the [uterus](https://embryo.asu.edu/search?text=uterus)***,***[***endometrium***](https://embryo.asu.edu/search?text=endometrium) prepares for the developing [***blastocyst***](https://embryo.asu.edu/search?text=blastocyst) to attach to it via many internal changes. Without these changes [implantation](https://embryo.asu.edu/search?text=implantation) will not occur, and the embryo sloughs off during [menstruation](https://embryo.asu.edu/search?text=menstruation). [Implantation](https://embryo.asu.edu/search?text=implantation) process differs in mammals, many respects between those mammals in which the females have ***estrous cycles,*** and those mammals in which the females have ***menstrual cycles***.

As known, the [***ovary***](https://embryo.asu.edu/search?text=ovary) releases an unfertilized [***egg***](https://embryo.asu.edu/search?text=egg)***cell***, called an [***oocyte***](https://embryo.asu.edu/search?text=oocyte), which then travels down the fallopian tube. The [egg](https://embryo.asu.edu/search?text=egg) is enveloped in an extracellular matrix called the [***zona pellucida***](https://embryo.asu.edu/search?text=zona%20pellucida)***.*** Sperm can fertilize the [egg](https://embryo.asu.edu/search?text=egg) in the [***zona pellucida***](https://embryo.asu.edu/search?text=zona%20pellucida) (ZP), which prevents the [fertilized egg](https://embryo.asu.edu/search?text=fertilized%20egg), the [***zygote***](https://embryo.asu.edu/search?text=zygote), from adhering to the wall of the fallopian tube. If the [***zygote***](https://embryo.asu.edu/search?text=zygote) implants in any area besides the [***uterus***](https://embryo.asu.edu/search?text=uterus)***,*** the result is an [***ectopic pregnancy***](https://embryo.asu.edu/search?text=ectopic%20pregnancy). This condition prevents the complete development of the embryo, and it can cause fatal hemorrhaging in the pregnant female.

As the [zygote](https://embryo.asu.edu/search?text=zygote) moves through the fallopian tube it undergoes several rounds of cell division, a process called ***cleavage.*** These cell divisions produce the [***inner cell mass***](https://embryo.asu.edu/search?text=inner%20cell%20mass) ***(ICM***), which will become the ***embryo*** and the ***trophoblast*** which surrounds the ICM and interacts with maternal tissues. Together, the ICM and the trophoblast are called the [***blastocyst***](https://embryo.asu.edu/search?text=blastocyst)***.*** A [blastocyst](https://embryo.asu.edu/search?text=blastocyst) successfully implants in the [uterus](https://embryo.asu.edu/search?text=uterus) when, as the ZP exits the fallopian tube, the [blastocyst](https://embryo.asu.edu/search?text=blastocyst) leaves the ZP and binds to the [***endometrium***](https://embryo.asu.edu/search?text=endometrium)***.***

The [endometrium](https://embryo.asu.edu/search?text=endometrium) is one of the few uterine surfaces to which a [blastocyst](https://embryo.asu.edu/search?text=blastocyst) cannot always implant. The properties of the [endometrium](https://embryo.asu.edu/search?text=endometrium) change, and only in a brief window can the [blastocyst](https://embryo.asu.edu/search?text=blastocyst) implant on the tissue. In [humans](https://embryo.asu.edu/search?text=humans), that window includes *days six through ten* after [***ovulation***](https://embryo.asu.edu/search?text=ovulation). Just prior to [ovulation](https://embryo.asu.edu/search?text=ovulation), the [endometrium](https://embryo.asu.edu/search?text=endometrium) begins to thicken and to expand in response to the release of [***estrogen***](https://embryo.asu.edu/search?text=estrogen)from the ovaries. As the embryo moves through the [fallopian tubes](https://embryo.asu.edu/search?text=fallopian%20tubes), the [endometrium](https://embryo.asu.edu/search?text=endometrium) proliferates, changes in shape, becomes receptive to [implantation](https://embryo.asu.edu/search?text=implantation), and produces a hospitable environment for the embryo. Signaled by the release of [***progesterone***](https://embryo.asu.edu/search?text=progesterone)from the ovaries, a series of changes called ***decidualization*** occurs, which are the gathering of white blood cells around endometrial arterioles, or blood vessels leading from arteries to capillary beds. As that vasculature forms, a molecule that stores energy, called glycogen, accumulates in the expanding connective tissues of the [uterus](https://embryo.asu.edu/search?text=uterus). Furthermore, the [endometrium](https://embryo.asu.edu/search?text=endometrium) swells as interstitial fluid accumulates in it. The [endometrium](https://embryo.asu.edu/search?text=endometrium), swollen with interstitial fluid, vasculature, and nutrients, provides a hospitable environment for [embryogenesis](https://embryo.asu.edu/search?text=embryogenesis).

As the [blastocyst](https://embryo.asu.edu/search?text=blastocyst) moves through the [uterus](https://embryo.asu.edu/search?text=uterus) it realigns itself so that the [inner cell mass](https://embryo.asu.edu/search?text=inner%20cell%20mass) is adjacent to the uterine wall, and the trophoblast contacts the [endometrium](https://embryo.asu.edu/search?text=endometrium). The position of the ICM in relation to the [endometrium](https://embryo.asu.edu/search?text=endometrium) establishes the ***head to tail, or dorsal-ventral, axis*** of the embryo, with the dorsal side of the embryo facing the uterine wall. This is the first embryonic event that dictates the [organization](https://embryo.asu.edu/search?text=organization) of the future body. Successful [implantation](https://embryo.asu.edu/search?text=implantation) depends on the [*blastocyst*](https://embryo.asu.edu/search?text=blastocyst)binding to the [*endometrium*](https://embryo.asu.edu/search?text=endometrium)*.*

There are many molecules that are thought to dictate this interaction, but ***integrins***, a type of cell-adhesion molecule, have been identified as a primary component. Integrins extend from the lining of the [**uterus**](https://embryo.asu.edu/search?text=uterus) and from the surface of the [***blastula***](https://embryo.asu.edu/search?text=blastula).

Integrins have many functions in nearly all tissue types, which are as follows;

* They play role in cell adhesion.
* Conveying information about the extracellular environment to the [nucleus](https://embryo.asu.edu/search?text=nucleus).
* Modulating the local immune response.
* Immediately following [implantation](https://embryo.asu.edu/search?text=implantation), integrins help regulate gene expression in the embryo.

Despite the contact between the [***blastocyst***](https://embryo.asu.edu/search?text=blastocyst) and the[***endometrium***](https://embryo.asu.edu/search?text=endometrium)***,***[***implantation***](https://embryo.asu.edu/search?text=implantation) can fail. There are many potential causes of errors. If [implantation](https://embryo.asu.edu/search?text=implantation) does not occur, ***the***[***endometrium***](https://embryo.asu.edu/search?text=endometrium) ***breaks*** ***down and sheds, along with the***[***blastocyst***](https://embryo.asu.edu/search?text=blastocyst)***, as part of the menstrual cycle***. However, if ***a***[***blastocyst***](https://embryo.asu.edu/search?text=blastocyst)***does implant, then the***[***endometrium***](https://embryo.asu.edu/search?text=endometrium)***remains in the***[***uterus***](https://embryo.asu.edu/search?text=uterus)***, and together with uterine tissue, becomes the maternal portion of the***[***placenta***](https://embryo.asu.edu/search?text=placenta)***, called the deciduas.***

Once the [blastocyst](https://embryo.asu.edu/search?text=blastocyst) adheres to the uterine wall, the trophoblast secretes enzymes that digest the extracellular matrix of endometrial tissue. The trophoblast cells then begin to intrude between the endometrial cells, attaching the [blastocyst](https://embryo.asu.edu/search?text=blastocyst) to the uterine surface. Further secretions of enzymes allow the [blastocyst](https://embryo.asu.edu/search?text=blastocyst) to bury itself deeply among the uterine stromal cells that form the structural components of the [uterus](https://embryo.asu.edu/search?text=uterus). Subsequently, trophoblast cells continue to divide and form two [*extra embryonic membranes*](https://embryo.asu.edu/search?text=extraembryonic%20membranes)*.* These membranes form the fetal portion of the [*placenta*](https://embryo.asu.edu/search?text=placenta) called the [***chorion***](https://embryo.asu.edu/search?text=chorion)***.*** Additional enzymes and signaling factors secreted by these membranes remodel the uterine vasculature to bathe the fetal or embryonic blood vessels in maternal blood. Chorionic villi are the folds of tissue and blood vessels that connect maternal and fetal blood pools. Maternal blood diffuses into the villi, and it travels through them into the [***fetus***](https://embryo.asu.edu/search?text=fetus)***'s vasculature.*** Similarly, fetal blood diffuses from the villi and into the maternal vasculature. Normally fetal and maternal blood do not mix, but the relationship between the two circulatory systems enables the transfer of nutrients and oxygen to the [fetus](https://embryo.asu.edu/search?text=fetus) or embryo, and carbon dioxide and urea from the [fetus](https://embryo.asu.edu/search?text=fetus) to the mother.

While unique to mammals as a reproductive process, [implantation](https://embryo.asu.edu/search?text=implantation) is not unique to the [uterus](https://embryo.asu.edu/search?text=uterus) and the trophoblast. The same trophoblast enzymes that digest the [*endometrium*](https://embryo.asu.edu/search?text=endometrium) are also used by tumor cells to burrow into tissues throughout body. Tumor cells use the same growth factors as the trophoblast to attract maternal blood vessels, which then interact with the [chorion](https://embryo.asu.edu/search?text=chorion), and to provide nutrients to the expanding mass. In addition, the changes in the [endometrium](https://embryo.asu.edu/search?text=endometrium) during decidualization such as swelling, the accumulation of white blood cells, and the general activation of the maternal immune system, are consistent with a response to the presence of pathogens or tumors.