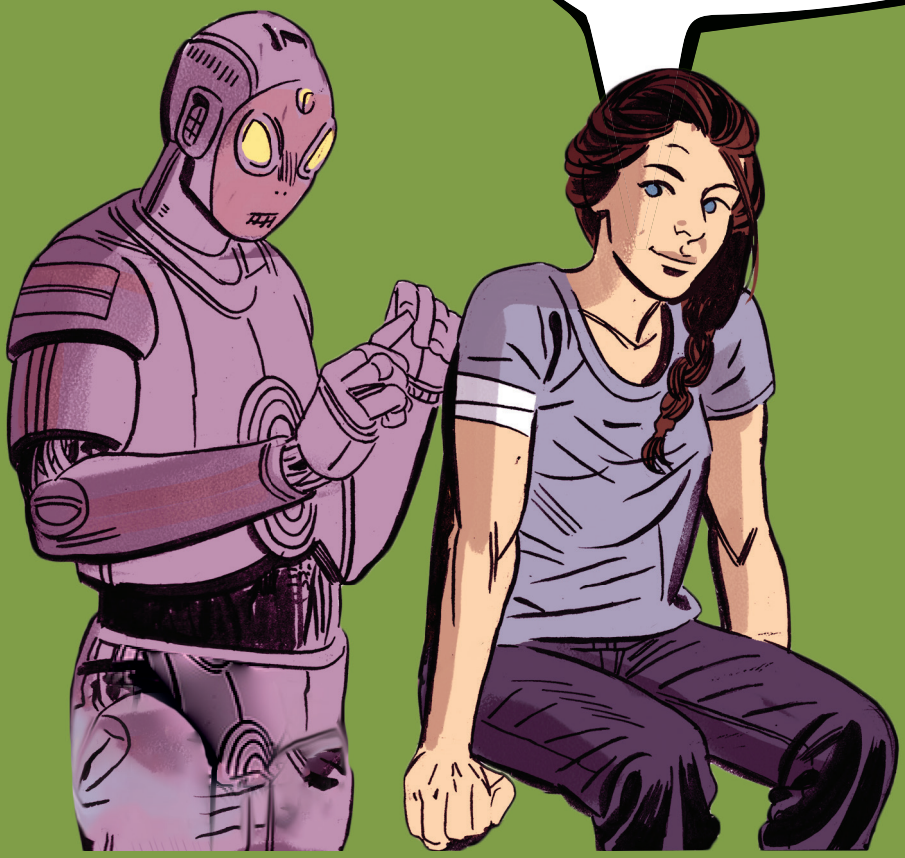
LET'S SCIENCE!

7

Veronica Grandi
Mara Bianchini

FROM CONCEPTION TO BIRTH

An amazing journey



IBSA FOUNDATION for scientific research

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Repubblica e Cantone Ticino
Dipartimento dell'educazione, della cultura e dello sport

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PREFACE

How familiar are we with the repercussions of scientific research and medical practice for our daily lives? What are the "passions" and motivations that drive researchers and healthcare professionals? What do we know about their professions?

Society strives to make science and its implications known to ordinary people in many different ways. Just think, for example, of the variety of leaflets promoting the importance of a healthy lifestyle and well-being in general. Of course, school does its part as well, introducing the principles of scientific literacy and raising awareness of a series of issues that help foster scientific thinking among young people.

These considerations are in fact the starting point for the *Let's Science!* project, carried out by the IBSA Foundation for Scientific Research in collaboration with the Department of Education, Culture, and Sport of the Canton of Ticino (DECS). The partnership has made it possible to identify interesting topics that have been addressed by the project, getting scientists working in the canton involved. Two different worlds that are often far apart – scientific research and school – have thus been brought together, promoting dialogue between professionals and students through themed workshops, in order to develop awareness of both the topic itself and how to communicate it.

But what was the range of topics the project would address and what considerations led to certain strategic decisions? Science and research are advancing rapidly, especially in biomedicine and related disciplines, and the continuous expansion of fields of investigation requires a constant effort to stay up to date, in order to both maintain a historical perspective and accommodate the numerous innovations. Access to scientifically accurate information, conveyed in accessible language, opens up the opportunity for children to get to know and become passionate about topics that are generally considered "difficult".

And that's the idea behind the *Let's Science!* series, which aims to broaden the range of scientific topics that can be explored at school. The topics, which are interdisciplinary and directly related to individual health and well-being, are presented in an innovative way: the scientific text is in fact accompanied by a story that draws on the experience of cantonal middle school classes, who,

under the guidance of their teachers, developed original scripts, which were then translated into comics by professionals in the industry.

The only thing left for us to do is invite young readers to explore the fascinating fields of research presented by *Let's Science!*, which in turn open up opportunities for further questions and insights. Who knows, one of these readers might in turn one day become the one taking important steps forward in understanding the complexity of life and the delicate balance that allows us to be healthy and happy. Enjoy reading!

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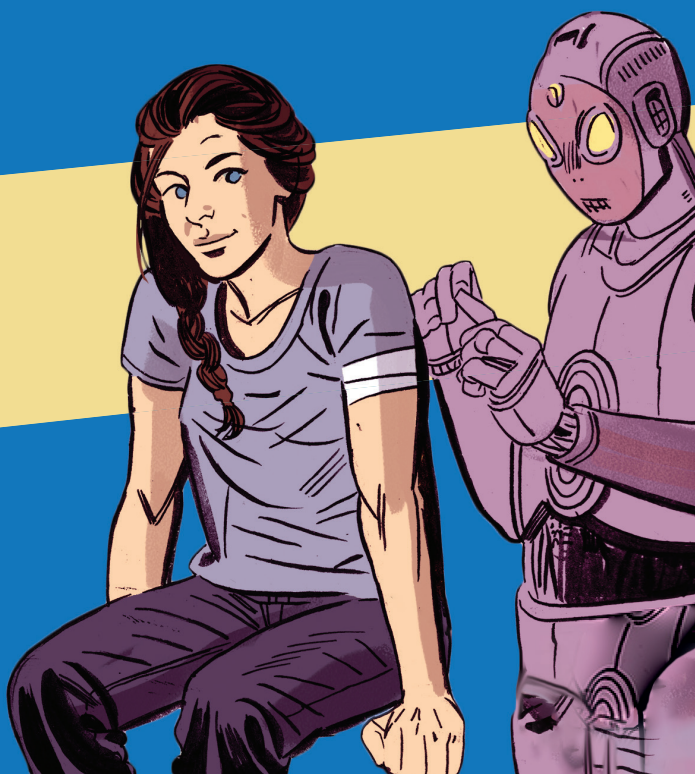
From conception to birth

PART ONE



INTRODUCTION

Human beings reproduce, something they have in common with other living beings. However, they are the only ones who study and understand the implications of their sexuality and reproductive process.

Men and women can only take a healthy approach to their sexuality if they are able to experience it in a way that is informed, aware, and free from prejudice. This is why the topic is part of a broader discourse related to both physical and mental well-being and health.

The following text is not intended to be a treatise on sexuality and reproduction. Instead, the aim is to tackle important issues by focusing on the individual and emphasising "well-being" during a period full of changes and new discoveries. In fact, this new perspective should also apply to women carrying a new life and to those who support them on this extraordinary journey. The hope is that knowledge and responsibility can finally be shared within the couple.

Scattered throughout the text, there will be suggestions for tackling and discussing several issues related to the period from conception to birth. Developing respectful and open attitudes helps build a fair society.

This booklet, aimed mainly at school-age children, is intended to help them improve the skills that help people to determine their own sexuality for themselves. This foundation is essential to experience fulfilling and responsible relationships and to be prepared to fully enjoy all those moments that bring new life into the world.

The women's liberation movements of the 1960s increased women's desire to put their talents and abilities to use outside the domestic sphere as well. Winning social recognition has often led to real competition with men. All this has led in part to a degeneration of femininity and disruption of the matriarchal expression of motherhood itself.

The hope is that in the coming years, the younger generations will be able to establish a symbiosis between the two roles, no longer seeing men and women as antagonists, but as complementary and fully benefiting from the rights hard won by past generations.

Gender equality is not an exclusively female achievement; male individuals also have the opportunity to bridge the cultural gap that separates men and women when it comes to emotional development, by renouncing the traditional "manly" male gender role. Now is perhaps the right time to replace ancestral forms of masculinity with new identity roles that foster relationships and give people the freedom to express their own uniqueness.

THE MENSTRUAL CYCLE

Although in recent years it has gradually been more included, the topic of menstruation continues to not be discussed or to have negative connotations in many cultures.

The taboo around this fundamental female physiological process means people feel like they shouldn't talk about it and feel the need to hide it, thus fuelling the development and spread of **false myths** and stigmatising attitudes. Rather than being seen as an expression of femininity, the menstrual cycle is associated with stereotypes of irritable, emotional women prone to impulsive decisions. In the absence of different cultural models, in the male imagination the figure of the woman on her period is likewise a hybrid, simultaneously threatening yet fragile. For the same reason, women themselves often tend to adopt the behaviours during their period that have been attributed to them for generations.

If you think about the most popular TV series, when have you seen a female character struggling with her period?

In addition to tradition, the message conveyed by adverts is also somewhat paradoxical. On the one hand, the image of a carefree, unrestricted woman is celebrated; on the other, the menstrual cycle is typically depicted in a way that emphasises the aspects of shame and secrecy. For example, there is often a reference, albeit subliminal, to the fear of "being dirty" and the flow is often mystified, probably for the sake "decency": adverts in which the menstrual blood is actually represented by a realistic blood-red liquid rather than a sterile blue or green gel are rare.

To try to understand how much perfection and potential are hidden behind menstruation, we begin this journey by summarising the fundamental steps that make a woman capable of procreating.

GENERAL CHARACTERISTICS

It all starts from **menarche**, which corresponds to a woman's **first menstrual cycle**. From that moment on, each woman goes through a series of physical changes that can be observed and appreciated for their evolution and variation. The cyclical process affects many bodily systems and functions: vaginal temperature, water retention, the composition and quantity of urine, body weight, breast size and consistency, amount of vaginal fluids, concentration level, psychological state, pain threshold...

The **menstrual cycle** is defined as the **period between the first day of menstruation and the beginning of the next period**. Normally, it lasts between 25 and 35 days. The bleeding phase, without clots, lasts on average 2-6 days [**figure 1** ]. There is great variability in both the duration of the entire cycle and the actual menstruation period from woman to woman. This means that, in a group of friends, each girl's experience of her cycle will be different: this natural variability should not be a cause for concern.

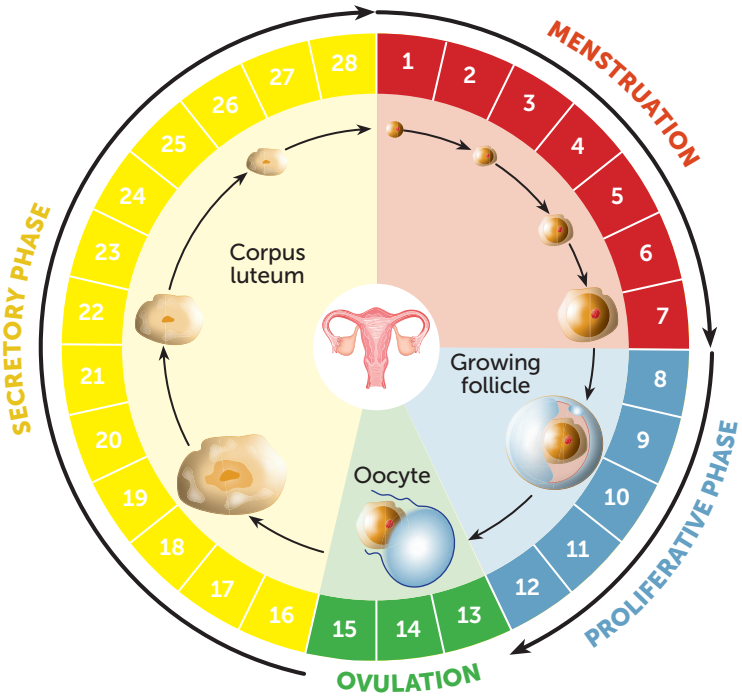
The variability of the cycle depends on many factors. Some variations are perfectly normal; others, on the other hand, may be indicative of a disorder, the origin of which is rarely linked to serious diseases. The deviation from normal can also be easily managed by adopting lifestyle precautions or opting for natural remedies.

Depending on the different phases of a woman's life, changes can occur in the menstrual cycle that can be classified as follows.

1. Type anomalies (related to the amount of bleeding). The most common are:

- **hypermenorrhea**: heavy menstruation often associated with blood clots. This is often due to the presence of fibroids (benign tumours) in the uterine wall;

Figure 1 The menstrual cycle



- **menometrorrhagia**: heavy and irregular periods. This could be normal and represent a transitional phase in some stages of life, such as the peri-menopause. In some cases, it may be a symptom of hormonal disorders, fibroids, or neoplasms.

2. **Frequency anomalies**:

- **hypomenorrhea**: short periods with very light bleeding. This may be caused by ovulation disorders or using hormonal contraceptives, such as the pill or the hormonal coil. It is only necessary to conduct a medical examination in the former case;
- **oligomenorrhea**: infrequent (>35 days) and usually light periods. The causes are often linked to hormonal problems that make ovulation impossible, such as in polycystic ovary syndrome (PCOS).

Amenorrhea is a lack of menstruation. It is normal:

- before puberty;
- during pregnancy;
- when breastfeeding;
- in menopause.

At other times, the absence of menstrual flow could instead be the first symptom of a disorder that ought to be investigated. In most cases, the ovaries do not release the oocyte, which makes it impossible for the woman to get pregnant.

Depending on the cause, amenorrhea may also be associated with other symptoms, such as headache, hirsutism, reduced libido, or vision problems.

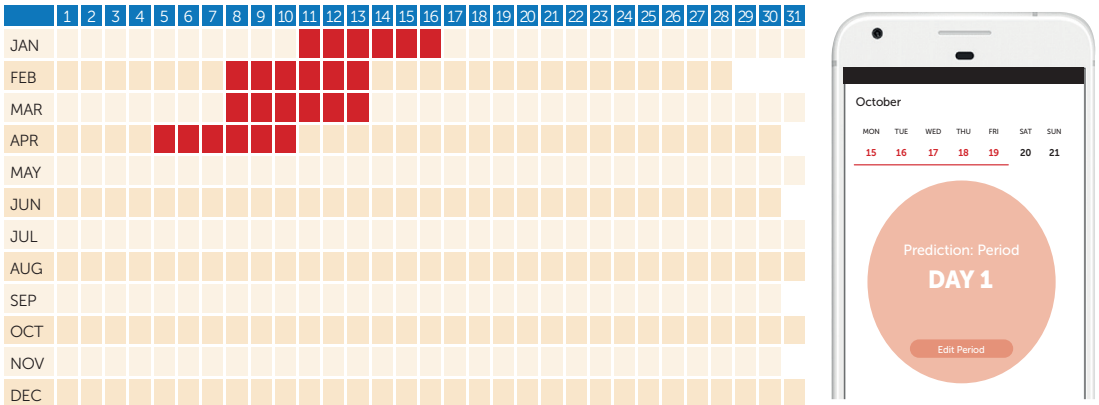
Some physiological states may result in amenorrhea when taken to the extreme. These include intense physical activity (often associated with being underweight and excessive loss of body fat), malnutrition (due to eating disorders or drastic diets), and chronic stress (associated with difficulty concentrating or sleep problems).

If you have any doubts about the duration, frequency, and intensity of your cycle, it is useful to use a paper or digital **menstrual diary** or period tracker [**figure 2**]. This simple tool allows you to check whether the monthly changes in your cycle fall within a normal range or not. In the latter case, the monthly diary may be very useful to your gynaecologist.

The term **dysmenorrhea**, on the other hand, refers to pain associated with the menstrual cycle. For some women, it occurs in the form of intense abdominal cramps that radiate to their back and legs. Symptoms such as nausea, vomiting, diarrhoea, or headache may also be present.

Dysmenorrhea does not have a specific cause, but is often associated with adolescence and tends to improve with the end of puberty or after pregnancy. The symptoms are more severe in women with long and heavy cycles [**figure 3**] and in smokers.

Figure 2 Menstrual diary



The problem can essentially be treated with two approaches depending on the symptoms and severity. The first solution is pharmacological and involves taking non-steroidal anti-inflammatory drugs (NSAIDs) as needed. The second is using a hormonal contraceptive that indirectly reduces intrauterine production of prostaglandin, the main cause of pain. Research is also being done on other approaches, such as transcutaneous nerve stimulation, dietary changes, or using specific food supplements.

Some tips to combat dysmenorrhea:

- do not smoke! Smoking makes dysmenorrhea worse;
- herbals teas or infusions based on Lady's mantle, yarrow, or symphytum can be an initial approach to treatment;
- vitamin B6 (contained in whole grains, beans, bananas, and nuts) improves symptomatology. A similar effect is reported for magnesium;
- some substances make symptoms worse: for example, caffeine, contained in coffee, tea, energy drinks, and chocolate.

Now let's have a look at this cyclical phenomenon that affects women in more detail: what are the physiological features? What are its implications for reproduction?

The menstrual cycle is more than just menstruation, which actually represents just one part of it. It can be defined as the interconnection of three fundamental

Figure 3 The menstrual pictogram

Toilets	Score
	1 ml
	3 ml
	5 ml

CLOTS	Score
	1 ml
	3 ml
	5 ml

PADS	TYPE	Score
	Day	1 ml
	Night	1 ml
	Day	2 ml
	Night	3 ml
	Day	3 ml
	Night	6 ml
	Day	4 ml
	Night	10 ml
	Day	5 ml
	Night	15 ml

TAMPONS	TYPE	Score
DATE	BRAND	
	Regular	0.5
	Super	1.0
	Super Plus	1.0
	Regular	1.0
	Super	1.5
	Super Plus	2.0
	Regular	1.5
	Super	3.0
	Super Plus	4.0
	Regular	4.0
	Super	8.0
	Super Plus	12.0

processes that guarantee the continuation of the species: ovogenesis, the ovarian cycle, and the uterine cycle.

◎ OVOGENESIS, THE OVARIAN CYCLE, AND THE UTERINE CYCLE

To properly understand the natural changes that take place in the female body during the menstrual cycle, we need to start with some definitions. This will enable us to tackle the implications of this complex process that allows human beings to pass on their genetic and cultural heritage from generation to generation.

Ovogenesis consists of the production of female gametes, called **oocytes**. It begins before birth and only ends with menopause [**figure 4**].

The **ovarian cycle** is the monthly sequence of events associated with oocyte maturation [**figure 5**].

Figure 4 The production of oocytes

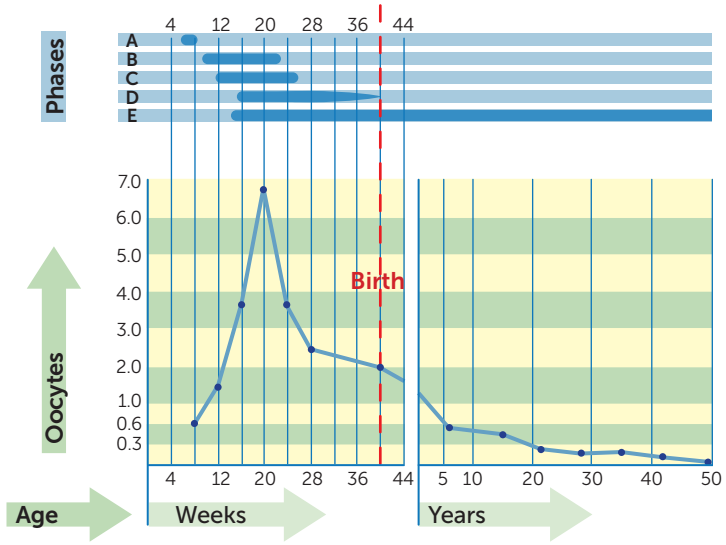
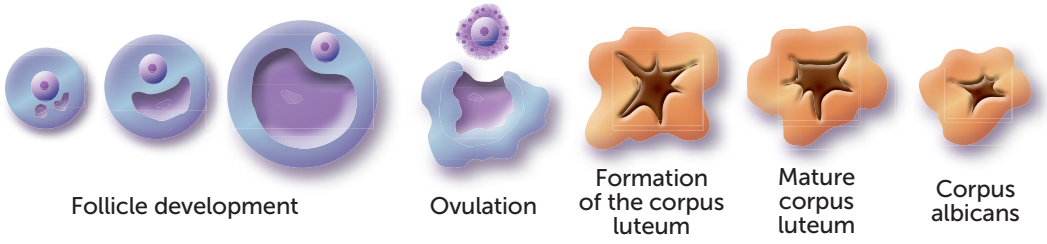


Figure 5 Follicular stages during the ovarian cycle

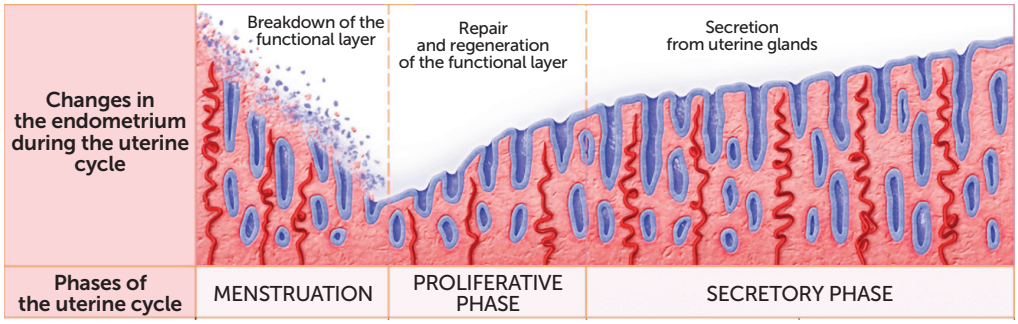


The **uterine cycle** consists of a series of events that are meant to prepare the uterine cavity for the implantation of a fertilised oocyte [**figure 6**].

The physical manifestations of the cycle conceal processes invisible to the naked eye. Now we'll take a look at how this mechanism is finely regulated by our body.

The **menstrual cycle** is the result of the interaction between the changes in the uterus and the cyclical hormonal variation, which regulates the various

Figure 6 Phases of the uterine cycle and endometrial changes



phases. A few important factors contribute to determining the frequency and regularity of the menstrual cycle.

First, the hypothalamus secretes gonadotropin-releasing hormone (GnRH), which causes the pituitary gland to secrete two specific gonadotropins (FSH, LH) that act on the female gonads, the ovaries.

The **ovaries** perform two important functions: the maturation of oocytes and the production of hormones. The main messengers produced by the ovaries are estradiol and progesterone. During the cycle, the **uterus** undergoes changes in response to variations in the concentration of these two hormones. In particular, **oestrogens** and **progesterone** regulate the three phases of the cycle within the endometrium in the uterus [**figure 7**]:

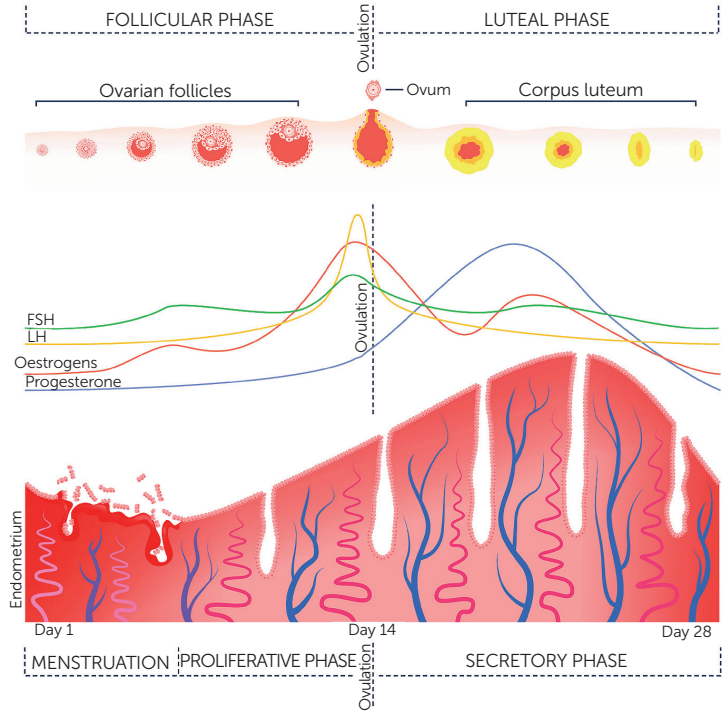
1. the **proliferative** or follicular phase (before the release of the oocyte);
2. the **secretory** or ovulatory phase (release of the oocyte);
3. the **luteal** phase (after the release of the oocyte).

The three phases occur in sequence in response to the production of hormones responsible for regulating the ovarian cycle. A new cycle begins about every 28 days.

The adjectives follicular and luteal refer to what is happening in the ovaries; proliferative and secretory refer to the changes within the uterus.

The beginning of the **follicular phase** coincides with the first day of menstruation. The endometrium breaks down and is shed, causing the typical bleeding.

Figure 7 The phases of the menstrual cycle



You may experience mood swings, breast tightness, cramps, back pain, or migraines. The onset of menstruation is generally considered a time when women's well-being declines. Understanding your body's signals and adapting to the moods that prevail in this phase allows you to recognise your cycle in its entirety as a physiological event. This will give you more control and the opportunity to take conscious action.

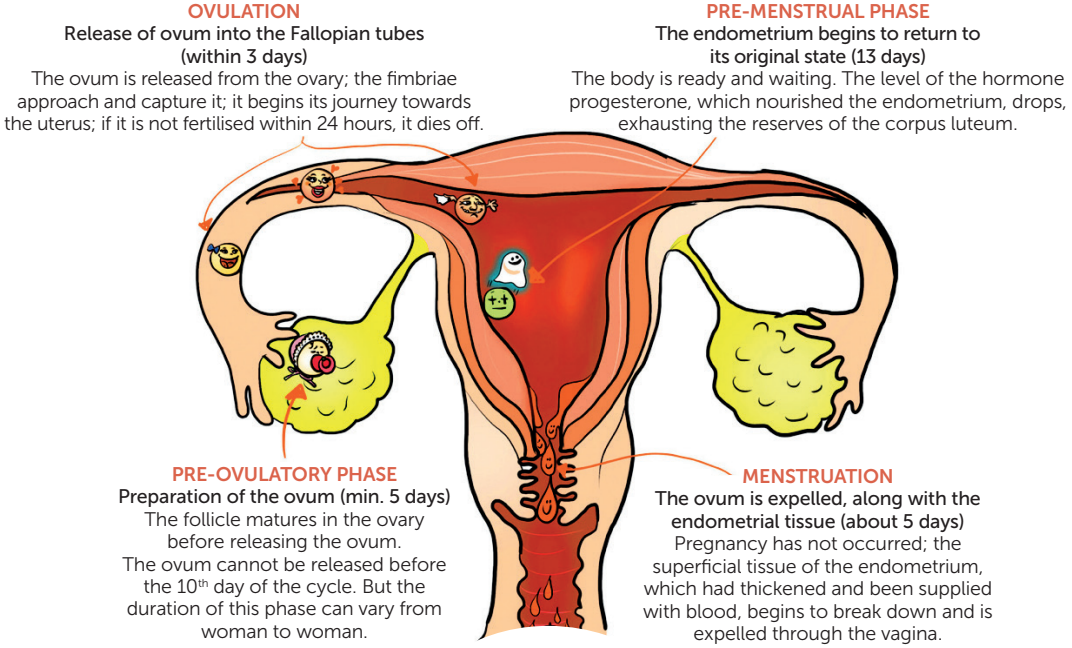
During this first phase, the oocytes begin their maturation process within specialised structures called **follicles**, under the effect of the hormone FSH, which is produced by the pituitary gland. The follicular cells begin to produce oestrogens, allowing the conclusion of the development of the oocyte and simultaneously stimulating the regeneration of the uterine endometrial layer. When the oocyte reaches maturity, hormone secretion by the pituitary gland increases considerably, leading to the **pre-ovulatory peak**.

The phases of the menstrual cycle do not depend only on the reproductive system, but are controlled by two fundamental structures located in the brain: the pituitary gland and the hypothalamus (part of the central nervous system).
In both sexes, the hypothalamic-pituitary-gonadal (HPG) hormonal axis does not just regulate reproductive and sexual functions. The sex hormones that characterise it also affect the immune system, the musculoskeletal system, and the brain.

The resulting **ovulation** will end with the **rupture of the follicle and the release of the oocyte into the Fallopian tube**, where it can be fertilised by a spermatozoon for a period of about 24 hours [**figure 8**].

The life span of the oocyte is limited, but fertilisation is still possible for a period of 6 days. The fertile window actually depends on how long the spermatozoa can survive, which is 3-5 days. Sexual intercourse can thus result in fertilisation 4-5 days before ovulation and during the 24 hours following it.

Figure 8 The ovarian and menstrual cycles



After ovulation, the **luteal or secretory phase** begins. The follicle cells left in the ovary transform into the **corpus luteum**, which has the function of releasing progesterone in particular. This hormone stimulates the transportation of the oocyte into the Fallopian tubes and prepares the uterine mucosa to accommodate the embryo that will reach it. The post-ovulatory phase is also called the secretory phase, as the endometrial glands in the uterus lengthen, dilate, and increase their secretion under the influence of the corpus luteum.

If conception does not occur, the corpus luteum begins to shrink and break down, progressively reducing its production of progesterone until a new cycle begins. The phenomenon of menstruation is caused by the rapid drop in hormone levels, which is also responsible for the mood changes typical of this period. Conversely, in the event of pregnancy, the corpus luteum continues to produce hormones for about 10-12 weeks.

So far, we have seen how the female body is a very precise machine, programmed to ensure optimal reproductive function. The gears that regulate it are very sensitive and delicate.

The menstrual cycle undoubtedly affects a woman's daily life. But the reverse is also true. In fact, there is an important correlation between lifestyle, diet, and chronic stress and some menstrual or sexual disorders, such as amenorrhea, decreased libido, infertility, and mood or metabolic disorders. Adopting a healthy lifestyle is therefore essential to preserve reproductive function.

The contraceptive pill is a reversible hormonal method of contraception. The most widely used pill involves a combination of oestrogen and progesterone, which works by inhibiting ovulation. This type of contraception also causes a thickening of the cervical mucus (making it difficult for sperm to get through) and a thinning of the endometrium (making it less suitable for the possible implantation of an ovum).

The menstrual cycle system can also be externally regulated to solve female fertility problems or to interrupt reproductive function. Humans have learned to do this by understanding the role of hormones and learning to mimic their function. It is important to bear in mind, however, that our bodies are made to function in harmony with the natural environment. Each disruption carries with it consequences ranging from trivial to potentially very serious.

FALSE MYTHS ABOUT THE MENSTRUAL CYCLE

You can't get pregnant on your period: FALSE
Every day of your period should be considered as potentially fertile, since the moment of ovulation is not known and spermatozoa can survive for several days.

You mustn't play sports while on your period: FALSE
There is no contraindication, unless a woman doesn't want to. On the contrary, it can be said that physical activity stimulates the body's production of serotonin and endorphins. These hormones may actually reduce the intensity of the symptoms that accompany menstruation, such as low mood, pain, or feeling unwell.

You cannot have sexual intercourse while on your period: FALSE
There are no physical contraindications. This is a strictly personal choice.

If a woman is a virgin, she cannot use cups or tampons: FALSE
The hymen only partially covers the vaginal opening and therefore does not prevent the insertion of a tampon or a menstrual cup.

You cannot have a bath or shower while on your period/cold water blocks the cycle: TRUE/FALSE
There's no reason a woman should give up baths or showers. Water may temporarily reduce the flow. This mechanical effect has no negative consequences and ends shortly after the water has been discharged.

It is better to not remove hair or dye your hair during your menstrual cycle: FALSE
These beliefs are probably rooted in some past customs, but they are not true.

People know when a woman is on her period: FALSE
This is not true. Women do not have a particular smell or walk differently when on their period. However, there should be nothing to hide: it is not anything "weird" but an expression of "normality".

FERTILISATION

In all species, a new living being is brought to life through fertilisation. This event marks a new beginning, the result of a collaboration between two individuals with the aim of procreating. For both females and males, reproduction represents an investment in the future that costs energy and carries certain risks. If there are no obstacles, the couple will be rewarded with the opportunity to pass on to future generations the unique genetic information deriving from the sharing of their characteristics.

In the specific case of human beings, the parents' lives will be enriched by the joy of raising a new individual. They will have the opportunity to share their experiences with the fruit of their union and pass on those teachings that define us as human beings endowed with culture.

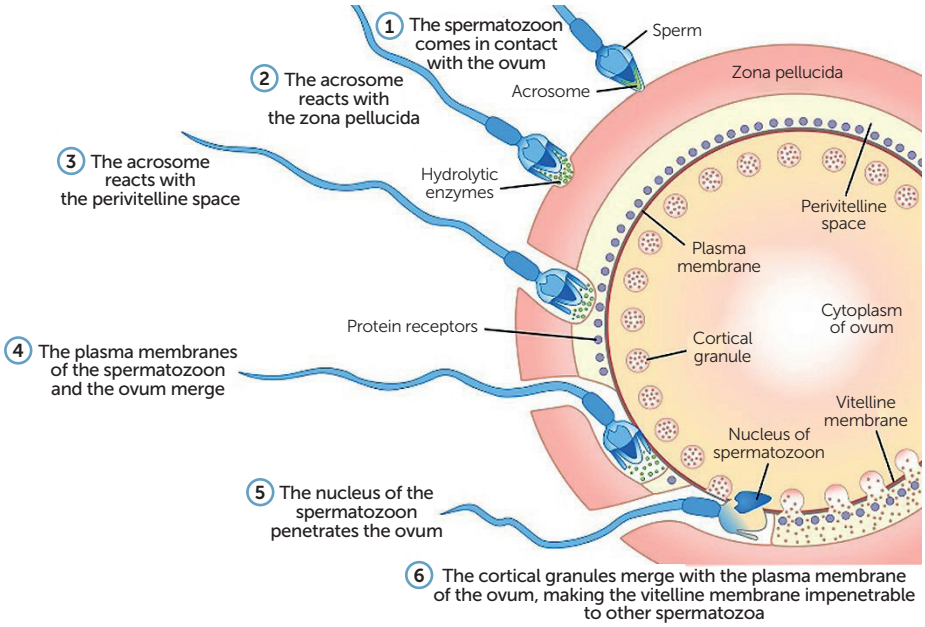
But let's take a step back and see how the woman's body prepares for the encounter with the male component. Women's investment takes the form of a complex and finely regulated process.

Ovulation is stimulated by luteinising hormone (LH), which is secreted by the pituitary gland. The ovum is released from the follicle surrounded by a membrane, called the **zona pellucida**, pellucid zone, or egg coat. Around it, the cells of the **cumulus oophorus** are arranged like rays, and together they are called the **corona radiata**. The cell mass measures several centimetres, offering a greater adhesion surface for spermatozoa. The movements of the **fimbriae** guide this cell mass into the **Fallopian tube**. As we have seen before, fertilisation must take place within 24 hours from when the egg is released from the follicle [**figure 9** ].

Several million **spermatozoa** are deposited in the vagina at the moment of ejaculation, but only a few thousand reach the Fallopian tubes and only a few dozen actually reach the ovum. The spermatozoa that reach the ovum have completed the **process of capacitation** and begin to make their way through the corona radiata. They try to reach the cell membrane of the ovum through enzymatic reactions. Only one spermatozoon can enter the mature ovum.

The other male gametes are equally important. In fact, by adhering to the surface of the corona radiata, they help dissolve the zona pellucida, which is digested thanks to the enzymes (hyaluronidase and acrosin) contained in

Figure 9 Fertilisation



the sperm's acrosome (a vesicle located in the cytoplasm in the anterior of the sperm's head). Let's have a look at what their task is in detail.

As soon as a spermatozoon reaches the **zona pellucida** of the ovum, the **acrosome reaction** is activated:

1. the vesicle containing the acrosomal enzymes merges with the plasma membrane of the spermatozoon and releases its contents into the zona pellucida;
2. the spermatozoon advances until it comes into contact with the plasma membrane of the ovum;
3. the membranes of the ovum and spermatozoon may finally merge;
4. the spermatozoon's nuclear material enters the cytoplasm of the ovum.

At the same time as the acrosome reaction is activated, the egg cell terminates the second meiosis and eliminates the second **polar body**. At this point, the ovum is finally mature: the **female pronucleus** is ready to join with the male counterpart.

The protein machinery and energy reserves necessary for the early stages of development of the new life will be made available by the mother. The female cell is also responsible for transmitting a very important part of the cell, namely the **mitochondria**, which are inherited only from the mother.

Fertilisation ends with the union of the female and male pronuclei: the zygote, with a diameter of 0.1 mm, is formed. The development of a new life begins!

While the acrosome reaction and the second meiosis of the ovum are taking place, the **cortical reaction** begins outside the egg cell. In the zona pellucida, enzymes are released that make the membrane impenetrable to other spermatozoa. This phenomenon is known as **polyspermy block**: preventing other spermatozoa from penetrating the oocyte reduces the risk of supernumerary chromosomes, which are incompatible with life.

FAILURES IN FERTILISATION

It can happen that a couple is unable to have children. When the spouses fail to **carry a pregnancy to term after two years** despite regular intercourse, this is referred to as **sterility**. This problem affects 1 in 7 couples and the number is constantly increasing.

In other animals, mating occurs while the female is fertile, increasing the chances of success. In humans, on the other hand, intercourse is regulated by environmental, psychological, and cultural factors, which often do not coincide with women's biological rhythms and can alter their hormonal balance. As we have already said, sperm only survive for 3-5 days in the female reproductive organs and the egg must be fertilised within 24 hours of being released from the ovary. If intercourse takes place at other times, it cannot result in pregnancy. This is why the pregnancy rate per cycle in a fertile couple is only 25%.

In addition, human gametes can be carriers of **genetic abnormalities** (number of chromosomes, genetic mutations) that can compromise the viability of the embryo or lead to the development of various kinds of syndromes (metabolic and/or structural abnormalities). It is very difficult to know how often conceptions occur that do not lead to a diagnosed pregnancy. There are very early miscarriages for which it is impossible to detect conception. Probably only 2% of conceptions with genetic abnormalities reach a term pregnancy.

Difficulties with conception can also be linked to infertility or hypofertility problems, which affect both men and women alike. The causes of infertility can be summarised as follows:

- 30% due to female causes;
- 30% due to male causes;
- 30% due to mixed causes;
- 10% unknown.

As far as men are concerned, the causes lie in **changes in the quality of semen** or in **decreases in or absence of spermatozoa**. Studies also report other factors related to testicular or endocrine abnormalities.

Ovarian ageing

The number of eggs a woman has depends on the her age.

During the first half of intrauterine life, there are about 6 million oocytes in the ovaries. Their number drops rapidly to 2 million before birth. The quantity available continues to decrease during childhood, reaching about 400,000 oocytes at puberty.

The quality of the oocytes is also directly influenced by lifestyle. Cigarette smoking, cannabis, and being overweight increase the rate of loss of oocytes.

Couples are trying to have children later and later in life and this inevitably contributes to increasing the cases in which conception is difficult.

Regarding the female component of possible causes of infertility, there are markers that can provide information on the number and quality of the follicles remaining and, consequently, on how long the woman will still be fertile.

In women, the first factor in sterility is related to the **ovaries** and **ovulation capacity**. **Hormonal disorders** (diabetes, hypo/hyperthyroidism), **damage to the Fallopian tubes** from previous infections, **malformations** of the organs of the reproductive system, or **diseases** such as endometriosis can make pregnancy impossible.

We must not forget, moreover, as we have already said, that eggs, unlike sperm, are formed in utero: their number is limited and their quality degrades over the years. The probability of conceiving a child therefore decreases as the woman gets older.

Then there are idiopathic causes of infertility, i.e. causes that do not result from a specific pathology. This

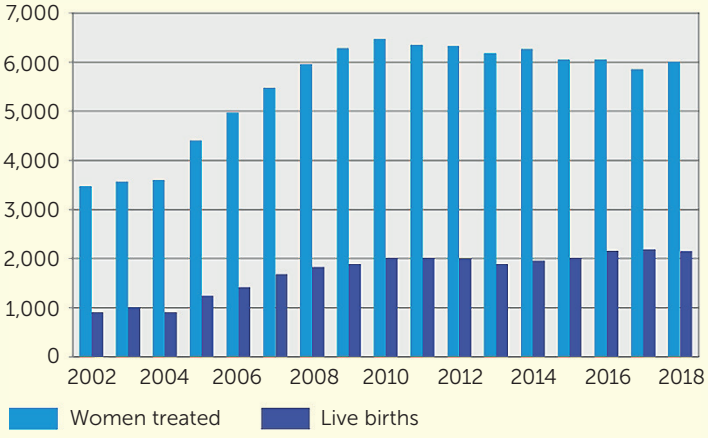
category also includes lifestyle and stress, which can generally be modified by the individual once they become aware of them.

At this point, we can say that there is a big difference between male and female investment in reproduction: the male produces a large number of gametes and can afford to lose nearly all of them. In fact, all it takes is for one spermatozoon to reach the goal, although many are needed for this to happen. Male gametogenesis begins with puberty under the influence of testosterone and remains relatively unchanged with advancing age. On the other hand, the woman expends a lot of energy to provide a single ovum for a period from menarche to menopause. We can therefore conclude that the female, who produces a single germ cell through a finely regulated and not risk-free process, invests more in the continuation of the species.

MEDICALLY ASSISTED PROCREATION (MAP)

Over the years, medicine has developed increasingly sophisticated techniques to help couples achieve the dream of a pregnancy, and more and more people are turning to medically assisted procreation (MAP) techniques.

MAP (*in vitro* fertilisation) in Switzerland. Years 2002-2018



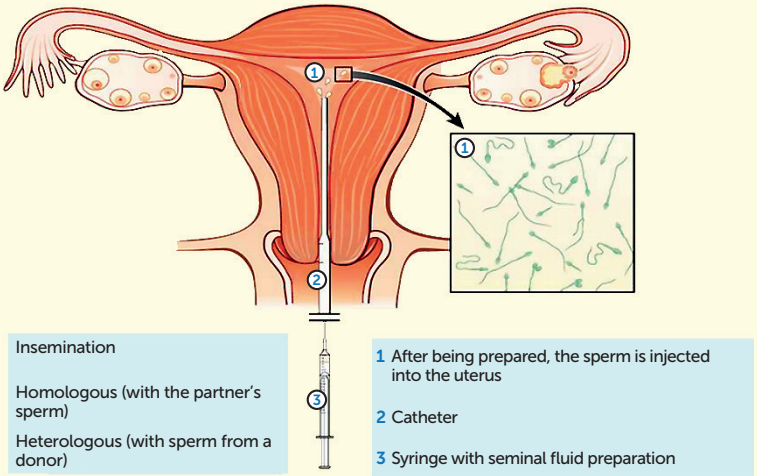
Source: Swiss Federal Statistical Office (FSO/OFS), 2020.

Depending on the cause of infertility, the solutions range from the very simple, such as regularising the cycle or scheduling intercourse at times suitable for conception, to more invasive techniques.

Artificial insemination consists of introducing sperm donated by the partner and prepared in the laboratory into the uterus, after an ultrasound confirms ovulation has occurred. This facilitates the meeting of gametes. The type of method is indicated when:

- the cause of infertility is unknown;
- there is a mechanical obstacle that makes it impossible for the two gametes to join;
- the quantity or quality of the semen is inadequate.

Artificial insemination



Insemination

Homologous (with the partner's sperm)

Heterologous (with sperm from a donor)

1 After being prepared, the sperm is injected into the uterus

2 Catheter

3 Syringe with seminal fluid preparation

With ***in vitro* fertilisation techniques** – the most common of which is **IVF-ET (*in vitro* fertilisation with embryo transfer)** – conception takes place outside of intercourse and the woman's body. The ovaries are stimulated by hormonal therapy to allow the simultaneous maturation of several ovarian follicles. The latter are collected and fertilised in the laboratory with the previously prepared sperm. The fertilised egg is then transferred into the uterus so that it can be implanted and initiate a pregnancy. When possible, IVF-ET is also used in the natural cycle, which does not involve the use of drugs to stimulate the ovaries,

thus avoiding much of the exposure to hormones for the woman. With this technique, the number of checkups is lower and the approach simpler.

When using cells taken from the couple, this is called **homologous fertilisation**. If an egg or sperm from a donor is used, it is called **heterologous fertilisation**. In Switzerland, sperm can only be donated from one spouse to the other. According to federal law, the donation of oocytes and embryos is prohibited, as is surrogacy; this is when a woman has an embryo implanted in her womb that has been fertilised *in vitro* by the gametes of a couple, to whom she will hand over the newborn at the end of the pregnancy.

Technology has made great strides in recent decades. Today, for example, it is possible to directly introduce the cytoplasm of a single spermatozoon into the oocyte through a micropipette. This technique, called **ICSI** (intracytoplasmic sperm injection), makes it possible to overcome male fertility problems related to the shape or mobility of sperm.

Compared to artificial insemination, *in vitro* fertilisation techniques have a higher success rate (from 20% to 60%, depending on the age of the woman) and can help with all types of infertility, both male and female.

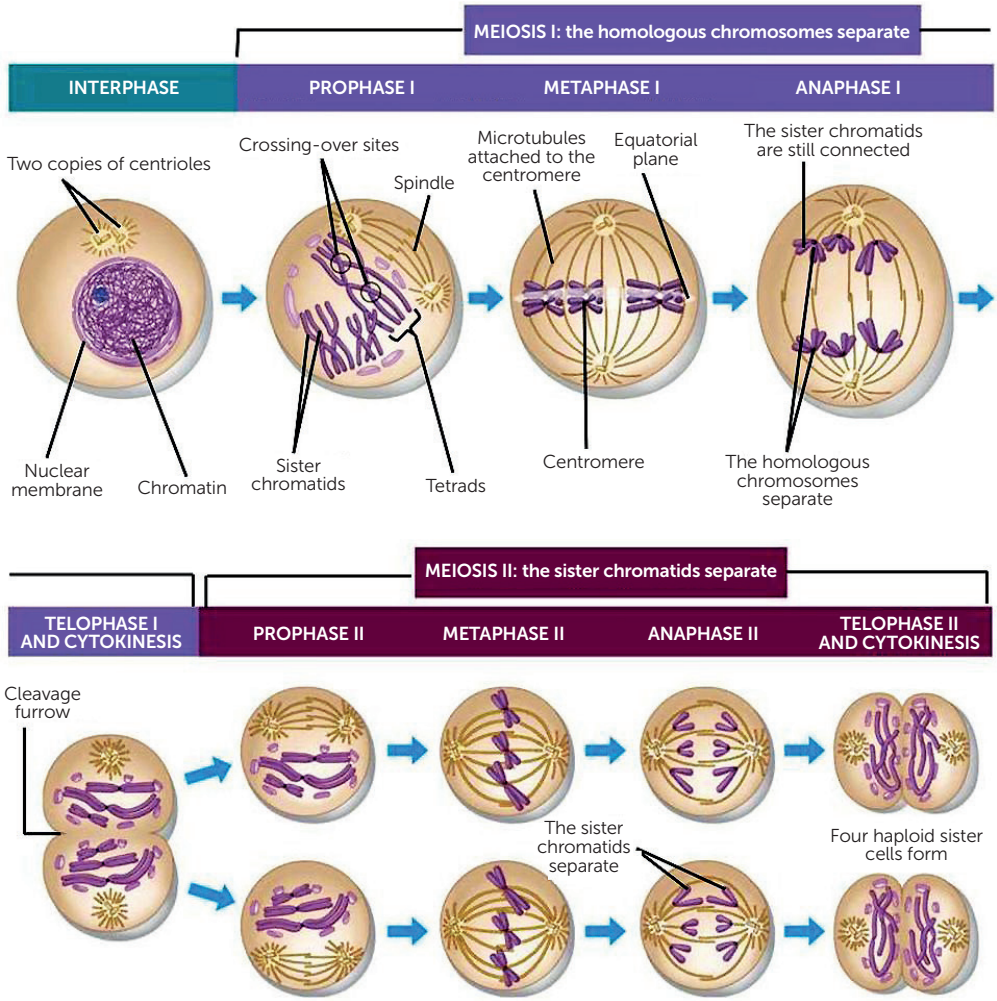
In Switzerland, following the vote in June 2016 that amended the federal law, it is now permitted to freeze embryos and perform genetic analysis on them. This change has allowed couples at increased risk for certain genetic diseases to access a pre-implantation diagnosis.

MAP procedures involve a very challenging journey for the couple undertaking it and a rather significant cost. In Switzerland, only part of the costs are reimbursed by the health insurance companies. IVF-ET/ICSI treatments are not covered by health insurance and the expenses are therefore fully borne by the couple.

A BIT ABOUT GENETICS: MEIOSIS AND THE PRODUCTION OF GAMETES

The process that leads to the maturation of both male and female gametes involves a transition from **somatic cells** (diploid cells with two copies of each chromosome, or 2n) to **sexual cells** (haploid male and female gametes with one copy of each chromosome, or n). This transition takes place thanks to **meiosis**, which in turn is divided into meiosis I and meiosis II [**figure 10**].

Figure 10 Meiosis



Meiosis I starts from a diploid cell that contains 2 copies of each chromosome, called **homologous chromosomes**. Initially, the diploid cell replicates its DNA so that each homologous chromosome consists of two identical **sister chromatids**. At this point, the homologous chromosomes line up side by side, allowing them to exchange DNA sequences (**crossing over**).

The first meiotic division leads to the separation of the homologous chromosomes into two distinct nuclei (in the female gamete, these are called the first

polar body and the nucleus of the primary oocyte; both of these nuclei are diploid). The primary oocytes are waiting to mature inside the female gonads, halted in this stage for as long as fifty years.

At the time of maturation, the primary oocyte undergoes meiosis II, which takes place without prior DNA duplication; the sister chromatids are thus separated into two further distinct nuclei, which are haploid this time (after fertilisation, they are called the "ovum" and the "second polar body").

Thanks to the recombination that occurs during meiosis I, the pronuclei contain a set of genetic information distinct from that carried by the parents, thus promoting genetic variability among the offspring.

EMBRYO FORMATION AND IMPLANTATION

From the moment of fertilisation, the new individual initiates a series of very delicate programmes, meticulously coordinated with each other. The incredible development process will transform the single undifferentiated cell, the **zygote**, into a baby composed of billions of highly differentiated cells that will allow it to develop into an adult who will in turn one day be able to reproduce. This process takes place in the mother's uterus and takes an average of 40 weeks.

On our fantastic journey, we just witnessed the male gamete meet the female gamete. At this time, the zygote is a cell that contains the male pronucleus and the female pronucleus in its cytoplasm. Both begin replicating their DNA and, after about 30 hours, merge to temporarily form a 4n cell. The first **mitosis** occurs immediately and the first two **blastomeres** are formed. In the next few hours, repeated cell divisions occur, rapidly increasing the number of cells that make up the zygote, without increasing its volume.

On the third day, the fertilised ovum, now called a **morula**, is composed of 8-18 blastomeres and reaches the uterus. The morula undergoes various structural changes. The cells become tightly bound together without leaving empty spaces and are joined together by dense connections; the outer cells are smaller than the inner ones. This process is called **compaction**. All morula

cells are classified as **totipotent**; this means that each cell can give rise to any type of cell in the body.

The morula then turns into a **blastocyst**, where the first differentiation in development occurs. In fact, two groups of cells are distinguished in the blastocyst:

- outer cells, which will comprise the **trophoblast** that will go on to form the foetal adnexa;
- inner cells, which will constitute the **epiblast** that will form the embryo and extraembryonic tissues.

Liquid pools in the centre, which will go on to form an internal cavity called the **blastocoel or yolk sac** [**figure 11**].

The blastocyst remains free in the uterine cavity for about two days and, after the zona pellucida breaks down, will be implanted in the uterine endometrium only on the 6th day after fertilisation.

Figure 11 The stages of cleavage and implantation

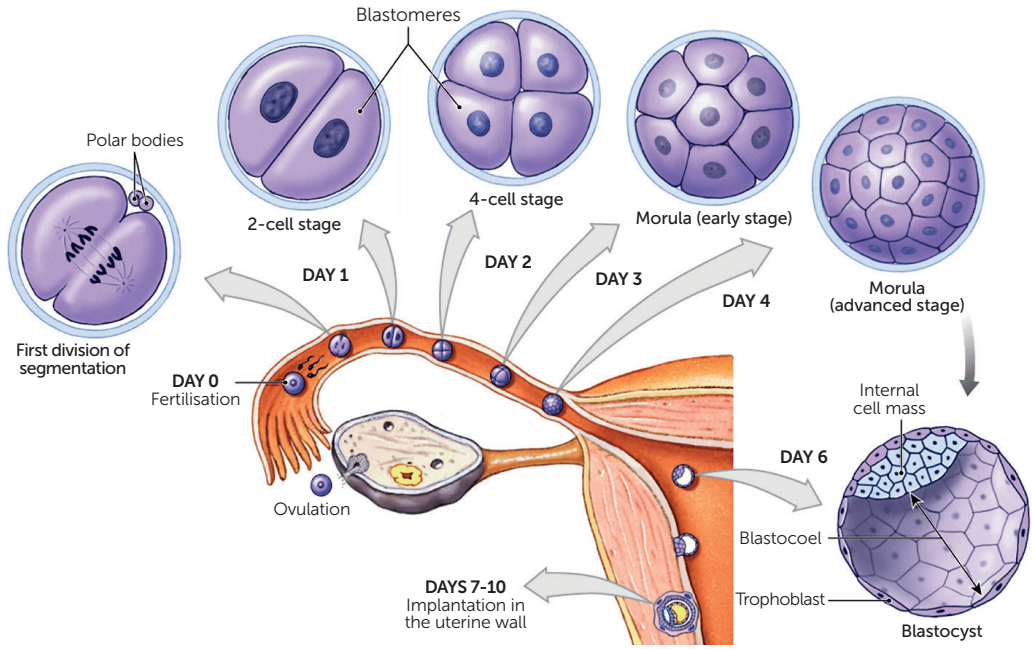
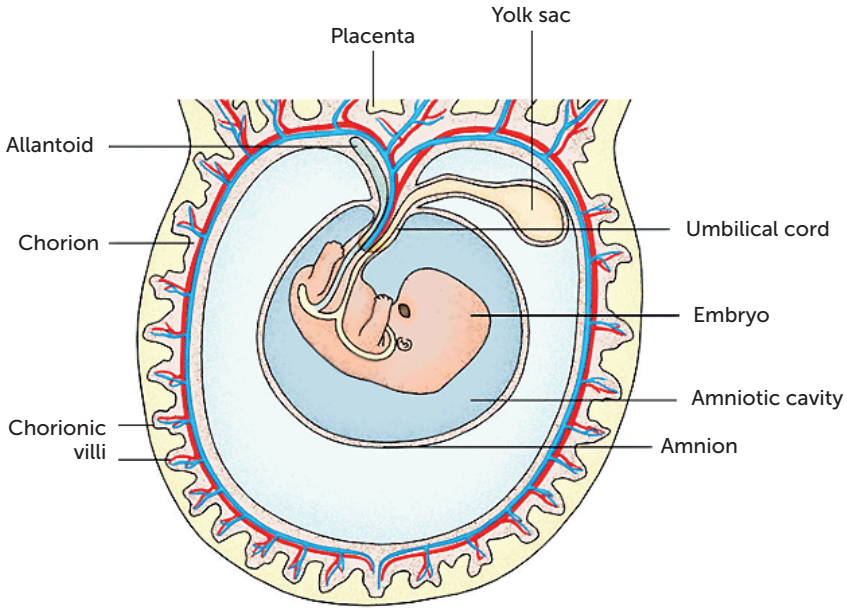


Figure 12 The embryo



Implantation occurs mainly between the **horn** and the **fundus of the uterus**. If implantation occurs at another site, it may make it difficult or impossible (as in the case of extrauterine, or ectopic pregnancies) to continue the pregnancy.

Implantation requires a higher concentration of progesterone than oestrogen in the plasma, which is maintained by the corpus luteum in the ovary. At the same time, the differentiation of cells into two distinct populations continues. The **cytotrophoblast** constitutes the internal cell mass, while the **syncytiotrophoblast** is responsible for the erosion of the uterine mucosa. This phase allows the blastocyst to be fully embedded into the endometrium. From now on, development takes place within this functional layer.

The morning-after pill prevents implantation by inverting the progesterone/oestrogen concentration ratio.

In the following days, the division and organisation of the embryo cells continue. The **amnion**, the **embryonic disc**, and the **yolk sac** are formed; the latter is the first element visible on an ultrasound [**figure 12**].

Two weeks after fertilisation, the syncytiotrophoblast produces the hormone hCG, which, with the support of the corpus luteum (active for about another ten weeks), ensures a high level of progesterone in the woman's body and thus the continuation of pregnancy.

The new hormonal balance can cause nausea, vomiting, tiredness, and emotional lability. These symptoms – along with a late period – are what lead the woman to suspect she may be pregnant.

Implantation in the mother's womb also marks the moment when a competition for nutrients begins between the mother and the embryo. The symptoms of pregnancy make the needs of the new life very clear for the body of the pregnant woman, who will evaluate whether she is able to meet these demands. Hosting and preserving a new life while it develops is thus again an investment for the mother.

The strategy of growing embryos inside the body, thus directly supporting their needs, is not very common among living beings. Few animals, besides mammals, have developed this ability. This is why the mother's health is in all respects directly related to the health of the future child.

The developing embryo is thus a structure that pursues two purposes. The first aim is linked to the development and differentiation of the structures that will go on to form a new, perfectly functioning being. The second objective is to ensure a constant supply of nutrients so the embryo can grow and, at the same time, eliminate waste products from its metabolism.

PREGNANCY TESTS

The hormone hCG (human chorionic gonadotropin) is produced by syncytiotrophoblast and its level in the mother's blood increases steadily and considerably in the first few weeks of pregnancy. The body then excretes the hormone through diuresis.

If your period is late or you experience symptoms such as nausea or vomiting, you should suspect pregnancy. There are several quick tests available on the market, which can be carried out in just a few minutes. These tests analyse a urine sample for hCG, which is detectable as early as one week after conception. It is recommended that you use your morning urine and follow the instructions for use carefully. The reliability of the tests is about 97%.

If the result is positive, it is necessary to confirm the pregnancy with a blood test to check for the presence and concentration of the hormone.

The rapid tests can sometimes produce "false" negatives or positives. The former are often linked to performing the test too soon after fertilisation; the latter may be caused by some rare ovarian diseases or the use of certain drugs.

If you have any doubts about the effectiveness of the test, it is advisable to repeat it a few days later or to take a blood sample.

The Sexual Health Consultants of the Cantonal Hospital Authority (CoSS) offer women, including minors, the opportunity to carry out a free urine pregnancy test. The consultation also offers information and support for sharing the news with your partner or family.

TWINS

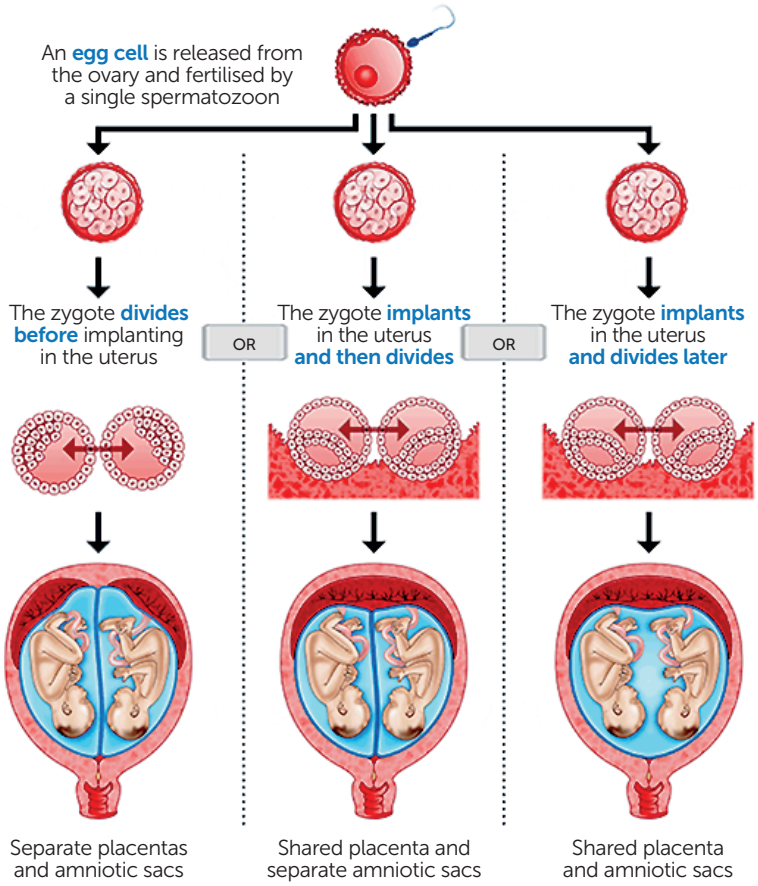
Sometimes a multiple pregnancy can occur. Until fairly recently, we only found out the number of children a woman had conceived at the time of birth. Technological advancements, in particular the use of ultrasound, have made it possible to reveal multiple pregnancies well in advance of delivery. Targeted medical check-ups are performed to reduce the associated risks (for example, prematurity or low birth weight). The increase in couples using MAP techniques has increased the number of twin births.

Scientific findings have also discovered why these kinds of pregnancies occur. The simplest and most common cause is the one that leads to **dizygotic**, or fraternal, twins. In this case, two mature eggs are released from the ovaries at the same time and fertilised. The fertilisation process is doubled and gives rise to two embryos, with different genetic make-up. It is therefore possible for the

two embryos to develop with very different characteristics from each other, for example a male and a female.

Identical, or **monozygotic**, twins, on the other hand, are born from a single egg cell fertilised by a single sperm, which divides in the first phases of cell multiplication, giving rise to two morulas that then develop separately. If the separation takes place early, the twins develop in the same amniotic sac and share the same placenta. When the division occurs at a later point, two placentas and two amniotic sacs or one placenta and two amniotic sacs may develop [**figure 13**]. These siblings carry the same genes, so they will be the same

Figure 13 Monozygotic twins



sex and have the same eye colour, blood type, and so on. For a long time, monozygotic twins have been the perfect "guinea pigs" for studies and research on socio-environment effects or the effects of the way children are raised.

Unfortunately, there is still a very rare possibility that is often associated with serious complications. It happens in about 1 in 120,000 births: we're talking about Siamese, or **conjoined twins**. In this case, the splitting of the embryo happens very late, probably due to environmental or genetic factors. The twins are always monozygotic, and thus of the same sex, and share organs or tissues.

WHAT HAPPENS DURING PREGNANCY?

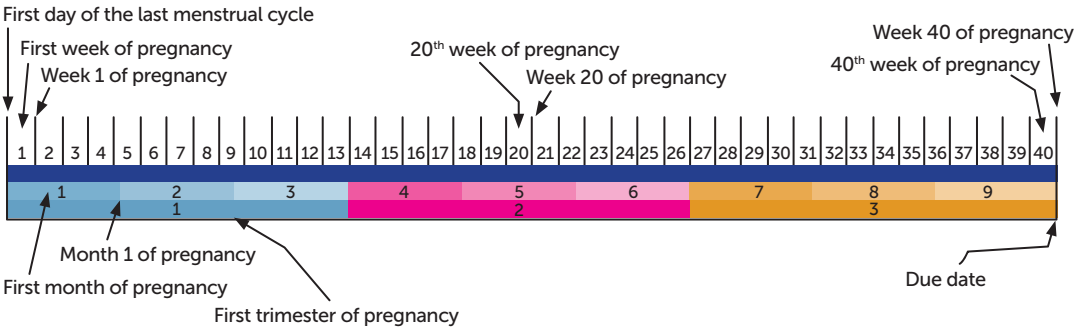
The **gestational age** is calculated from the first day of the woman's last period. This term does not exactly coincide with the beginning of pregnancy, but serves as a reference point to determine the probable date of ovulation and fertilisation.

The duration of pregnancy in humans is **280 days** (40 weeks, or 9 months and 10 days, or "ten moons") and is normally divided into three trimesters [**figure 14**]:

- **first trimester**: up to the 14th week; this is the period of development called pre-embryonic, embryonic, and early foetal; the rudiments of all organs and systems appear during these weeks;
- **second trimester**: up to the 24th week; the foetal organs and systems become fully developed; the foetus looks human and its proportions change;
- **third trimester**: up to birth; most systems become fully functional and this increases the chances of survival of preterm births.

Unlike most animal species, human babies are born very prematurely and it takes a long time for them to become independent. The main reason for this lies in the evolution of the human race: in fact, the transition from walking on all fours to walking upright significantly reduced the size of the woman's

Figure 14 Weeks of pregnancy



pelvis, which means the newborn must be born when its proportions are still compatible with the mother's anatomical spaces.

If the birth takes place between the 37th and 42nd week, this is called a **term delivery**. When it occurs before 37 weeks of pregnancy, it is referred to as a **premature delivery**, which can be caused by various factors, linked to the mother or the baby. A physically or mentally **stressful lifestyle**, for example, can overload the pregnant woman's body and induce early contractions. They can also be caused by a **viral or bacterial infection** or by **pre-existing diseases**, such as hypertension. In other cases, pregnancy with twins or foetal pathologies are the cause of a premature birth. In many cases, however, it is not possible to link premature delivery to a medical diagnosis.

The difficulties with adapting faced by the premature baby vary according to the gestational age: the closer the delivery is to term, the better the health of the newborn and the outcome of its development. For premature babies and their parents, the journey is very intense and requires hospitalisation in the neonatal care unit. The major complications are related to the **immaturity** of the premature baby's **organs** and functional systems, which need time to be able to properly function on their own. Compared to the past, the development of technology and medical skills now enables us to support the vital functions until the newborn is able to perform them independently, thanks to sophisticated analyses and machinery.

THE FIRST TRIMESTER

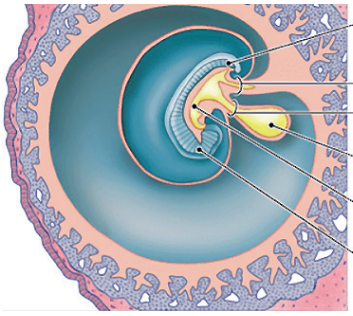
Embryonic development continues throughout gestation. From the 3rd week of pregnancy, **gastrulation** occurs: the cells are increasingly differentiated from each other and three layers (the ectoderm, endoderm, and mesoderm) are formed in the embryo, from which all the tissues of the body originate [**figure 15** and **table 1**].

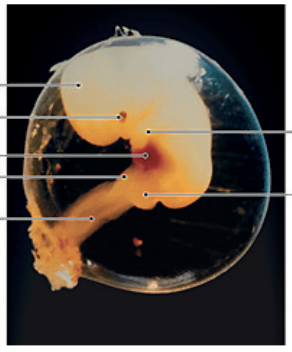
The organ formation phase, i.e. **organogenesis**, can now begin [**figure 16**]. The embryo measures about 3 mm; at 5 weeks, its heart begins to beat.

In the 6th week, the neural tube, the precursor of the brain and spinal cord, closes. At 7 weeks, the head is disproportionate to the rest of the body, on which the arms, legs, hands, and feet begin to be seen.

Figure 15 Formation of embryonic tissues and outline of organs: 4th week

The embryo now has a cephalic fold and a caudal fold. The constriction of the connections between the embryo and the surrounding trophoblast brings the vitelline duct closer to the connecting stalk.





4th week of development (length about 5 mm).

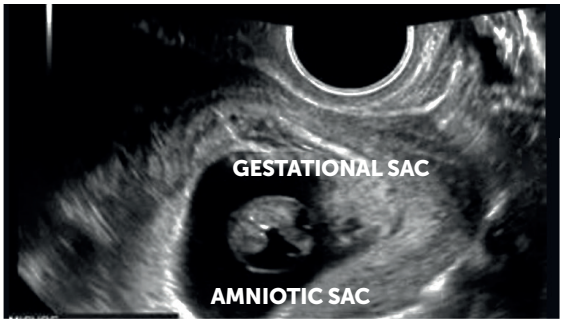
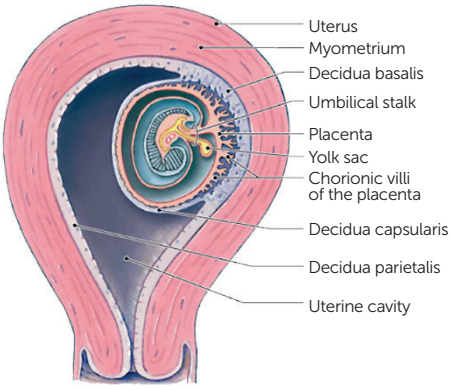
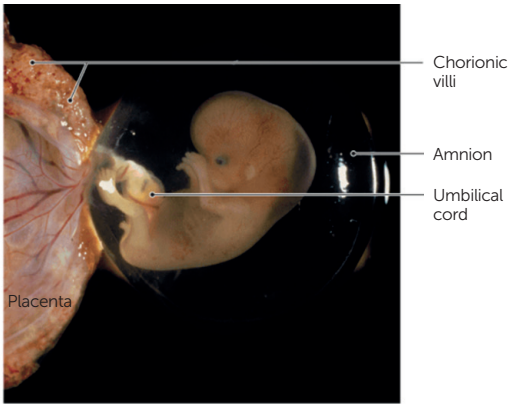


Table 1 Cell differentiation: 3rd week

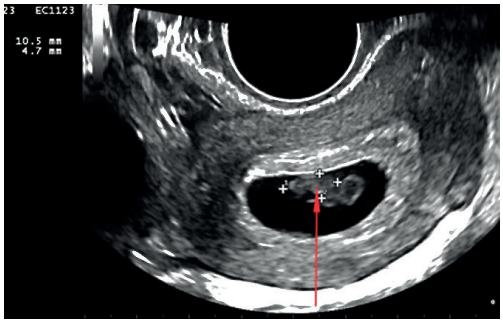
ECTODERM	ENDODERM	MESODERM
Nervous system	Epithelium of the digestive tract	Muscles
Epiderm	Respiratory system	Bones and cartilage
Glands	Digestive system glands	Urogenital system

Figure 16 Organ formation: 5th-8th week



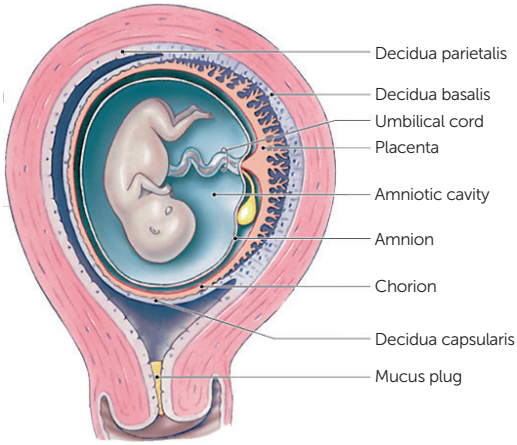


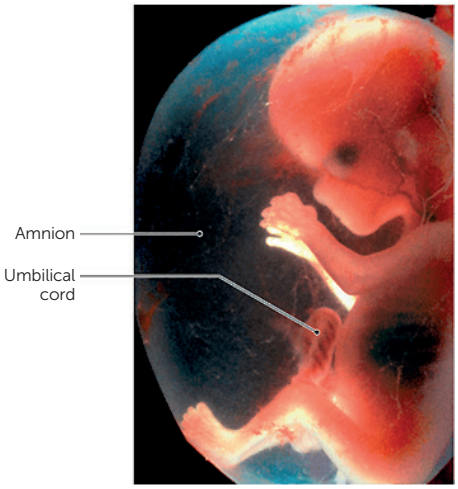
Fibre optic image showing human development in the 8th week (size about 1.6 cm).



At 10 weeks, the embryo takes on a shape that we can recognise as human. The fingers can be distinguished from each other and the big toes also begin to separate. It is possible to identify the nose, eyes, and mouth on an ultrasound [**figure 17**].

Figure 17 The embryo takes on a human shape: 10th-12th week of gestation





Fibre optic image showing human development in the 12th week (size about 5.4 cm).

At the end of the 12th week, the term embryo is no longer used and the term **foetus** is preferred: the new life now measures about 2 cm. The organs are almost all present and will continue to develop in the following weeks.

For most women, the end of the first trimester brings great relief. In fact, the risk of miscarriage decreases considerably, which coincides with the remission of symptoms such as nausea, vomiting, or fatigue.

Miscarriages are far from rare. In fact, about 20% of pregnancies are lost before the 20th week. It is estimated that 80% of these miscarriages occur before the 12th week, caused by chromosomal abnormalities in half of cases. The causes include the mother and father's age and tobacco consumption.

We have previously seen that the formation of the **foetal adnexa** [**figure 18**] began during gastrulation. This phase ends around the 12th week of pregnancy. The amnion encloses the embryo in a sac full of amniotic fluid (up to about 800 ml). The role of the colourless fluid is to protect the foetus from trauma, keeping it at a constant temperature and making it easier for it to move. The yolk sac provides the nutrients necessary for the development of the embryo until the placenta forms.

It is interesting to see how mother and foetus come into contact through shared structures: the **allantois** is an invagination of the foetus's endoderm which, merging with the **chorionic villi**, will transform into the **umbilical cord**, which usually contains one vein and two arteries.

One very important structure is the **placenta**, which is formed from both foetal tissues (chorionic villi) and maternal tissues (the endometrium). Exchanges between the foetus and the mother take place through this organ: maternal and foetal blood each flow in closed circuits, but the blood vessels are so

Figure 18 The foetal adnexa

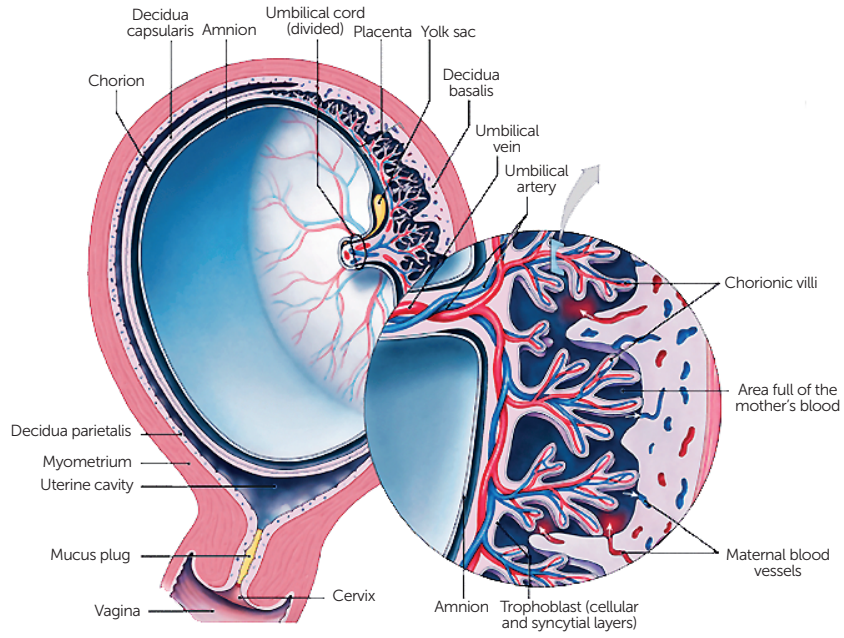
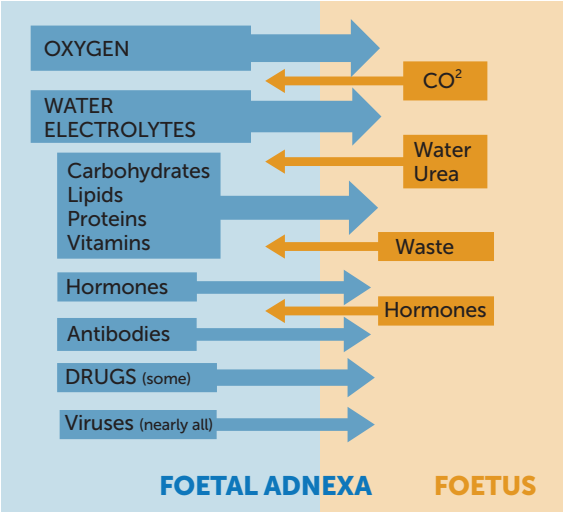


Figure 19 The functions of the placenta



close to each other that they allow the direct passage of nutrients, oxygen, and waste products between the mother and the foetus and vice versa. **Maternal antibodies** also pass into the foetus via the same mechanism: the baby thus acquires passive immunity, which will persist until a few weeks after birth.

In summary, the placenta is a highly differentiated organ that performs many functions [**figure 19**]:

- production of hormones that allow the pregnancy to be maintained;
- protection from infectious agents;
- foetal respiration through the exchange of oxygen and carbon dioxide;
- nourishment;
- elimination of waste;
- temperature regulation.

If part of the placenta detaches from the uterine wall, it causes major bleeding on the maternal side. The bleeding can threaten the survival of both the foetus and the mother.

THE SECOND TRIMESTER

After the uncertainty of the first few weeks, the second trimester is often when the pregnancy announcement is made. As we have already said, the initial discomforts, such as nausea and fatigue, usually disappear and the woman enters a phase of vitality and well-being supported by a new hormonal balance. She also begins to feel the foetus moving vigorously and with increasing coordination in her belly: in the beginning, it is a sensation like butterflies or air bubbles in her stomach, but after the 20th week, the mother learns to recognise the foetus's different movements.

These weeks of pregnancy are characterised by incredible foetal growth. The foetus will grow **to be about 25 cm long** and **weigh 900 g**. All its organs are now formed and continue their maturation process. Taste cells begin to work and hone their abilities thanks to the amniotic fluid that the foetus continues to swallow. It is precisely for this reason it often has hiccoughs.

The **cells in the eyes** become sensitive to light and the eyelashes and eyebrows appear. It is now able to pull many different faces and the ears become active, making the foetus move in response to sound stimuli. The network of **capillaries** extends and the **heart** beats at a rate of about 140 beats per minute to get blood flowing inside all the vessels. The head is now more proportionate to the body, which is covered with **lanugo** and **vernix caseosa**. The latter is an off-white secretion derived from the sebaceous glands that protects the foetus's skin from continuous exposure to the amniotic fluid. The lanugo and vernix caseosa disappear spontaneously during pregnancy or immediately after birth.

In females, the formation of the uterus and ovaries, which already contain the primordial follicles and oogonia, is complete between the 13th and 20th weeks. In males, the reproductive system forms and the testicles begin to descend into the scrotum in this period.

EXAMINATIONS DURING PREGNANCY

Every parent's greatest desire, especially with family planning and there being fewer pregnancies per couple, is to raise a healthy child. Ever since the

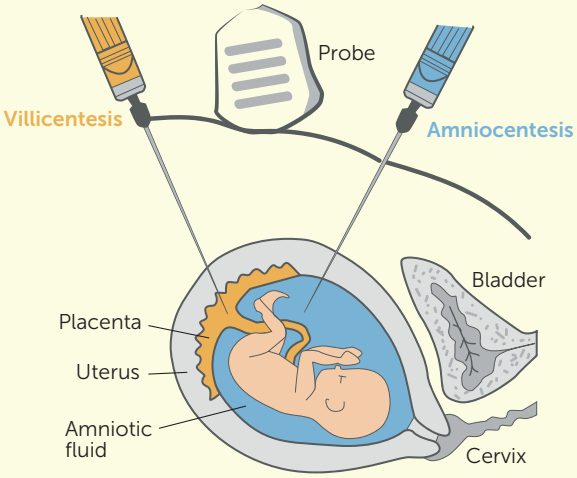
dawn of time, fortune tellers, magical rites, and folk beliefs have sought to grasp the secrets of the miracle of life and the child hidden in the mother's womb.

The correlation between maternal and foetal well-being has long been recognised. During pregnancy, therefore, women undergo regular checkups to detect the onset of certain diseases that can occur during pregnancy or the worsening of pre-existing conditions. Through clinical examinations, blood tests, and thorough interviews, the gynaecologist or midwife ensures that the woman does not develop complications and is informed of the recommendations she needs to follow to stay healthy.

Until a few decades ago, however, it was very difficult to verify the condition of the foetus. The women who looked after pregnant women would listen to the baby's heartbeat, initially with their ear resting on her belly and then with receivers that amplified the sound. They also relied on palpating the mother's womb to see if the birth was favourable.

In the 1950s, **ultrasound images** brought about a great revolution in obstetrics, finally making it possible to diagnose some congenital defects in the foetus.

Invasive prenatal diagnostics



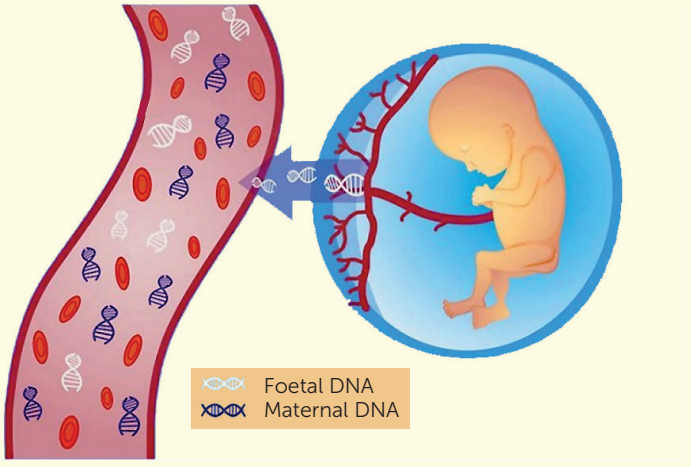
Prenatal examinations are basically divided into two large categories: **non-invasive** and **invasive**.

The former category includes several probabilistic tests that provide a probability percentage that the foetus might have anomalies by cross-checking multiple criteria, such as maternal age, some blood markers, and various ultrasound parameters. In the event that the probability is high, the couple can decide whether to proceed with invasive tests.

A few years ago, a revolutionary diagnostic technique made it possible to look for minimal traces of free foetal DNA in the mother's blood and to establish a complete karyotype. It is called **NIPT** (Non-Invasive Prenatal Testing), is performed from the 10th week of pregnancy onwards, and is harmless to the mother and the baby. The risk of error in this test is very low, but it cannot detect all foetal abnormalities.

The best known invasive test is **amniocentesis**, which is usually performed between the 16th and 18th weeks of pregnancy. A sample of amniotic fluid, containing foetal cells, is collected and analysed to determine the karyotype of the infant and to look for the most common genetic abnormalities. If abnormalities are found and the woman decides to terminate the pregnancy, a therapeutic (or medical) abortion involves the induction of contractions and the expulsion of the foetus by spontaneous delivery.

NIPT



In the case of patients at high risk or who opt for this method for other reasons, it is possible to perform **chorionic villus sampling** (CVS) as an al-

ternative. This allows the test to be performed earlier, between the 11th and 13th weeks of pregnancy, thus obtaining the result earlier. In the event that a pathology is detected, the woman may choose to terminate the pregnancy, which can be done surgically in the first 12 weeks of pregnancy.

Amniocentesis and chorionic villus sampling entail a risk of miscarriage in about 1% of cases.

Parents often believe that it will be less painful and the grieving process will be easier if the pregnancy is terminated early and by means of surgery. It is now recognised that the duration of gestation and the technique used have no influence on the grieving process that each couple will have to face.

The tests we mentioned look for the main known genetic diseases. However, we must not forget that scientific knowledge of the human genome is still very poor at present. It has not yet been possible to find the genetic correlations suspected of being the cause of certain conditions such as, for example, autism or sudden infant death syndrome (SIDS), also known as "cot death". Every parent should remember that prenatal diagnosis can therefore offer only partial reassurance of the health of the foetus.

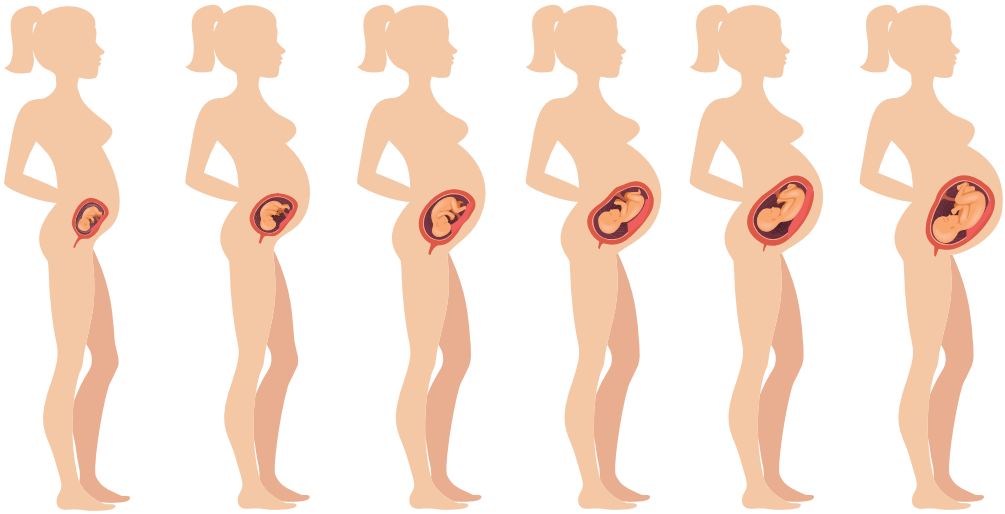
THE THIRD TRIMESTER

The third trimester begins at the 24th week and the volume of the mother's uterus increases considerably in this last stage of pregnancy [**figure 20**].

The main process that occurs during the final weeks of pregnancy is the formation of a reservoir of adipose tissue, which will account for about 16% of the baby's body weight at birth. The baby goes from weighing about 900 grams at the beginning of the trimester to an average of **3 kilos at birth**.

The central nervous system will continue to create **synaptic connections in the brain** that will allow the newborn to control its biological functions at birth. From the 24th week of pregnancy, the **pneumocytes** begin producing the surfactant that helps keep the pulmonary alveoli open. Although this lipid surfactant begins being produced early on, the baby is only able to breath

Figure 20 Growth of the foetus during pregnancy



on its own from the 34th week. In males, the descent of the testicles into the scrotum ends around the 29th week.

Due to the growth of the uterine volume and the new hormonal balance, women may present symptoms such as fatigue, nausea, or shortness of breath, just like in the first trimester. Having less space available, the movements felt by the mother change and take on a different strength.

During the final weeks, most women begin to become familiar with **uterine contractions**, which remain sporadic and almost always painless; they are not symptoms of labour, but indicate that the body is preparing for the event. They can be thought of as small trial runs.

WHY YOU SHOULD ADOPT A HEALTHY LIFESTYLE DURING PREGNANCY

We have seen how the placental barrier protects the foetus from contact with many substances and pathogens. However, other harmful elements can penetrate it. For this reason, the mother should adopt behaviours that do not endanger the baby's health.

FALSE MYTHS ABOUT PREGNANCY

You have to eat for two when you are pregnant: FALSE
The demands induced by pregnancy are not very high (about 300 calories/day) and are physiologically compensated for by the normal reduction in physical activities. Therefore, an increase in calorie intake is not necessary.

If the mother does not satisfy her cravings, the baby will be born with spots on its skin: FALSE
The cravings are probably dictated by the mother's new hormonal balance. In part, they are also linked to the mother's desire to be comforted and validated in her very important role by those around her.

Stomach acidity means the baby has a lot of hair. You can tell the sex of the child from the shape of the mother's belly: FALSE
Both myths belong to the group of folk beliefs that reflect the cultural environment but are not true.

Nicotine, for example can be responsible for miscarriages, premature births, or a low birth weight if it crosses the placenta and reaches the foetus. Children of mothers who smoke are born with a higher risk of developing allergies and becoming overweight. **Marijuana**, in addition to decreasing male and female fertility, also has very similar effects to tobacco. Babies of mothers who consumed tobacco, marijuana, and/or other substances experience more or less intense withdrawal symptoms (characterised by tremors and crying) after being born.

Alcohol is also a toxic substance that can pass through the placenta and reach the foetus. There is no quantity that can be considered harmless: any alcoholic beverage, no matter the type or strength, will harm the foetus. According to studies carried out in recent years, the children of women who consume alcohol during pregnancy often exhibit attention problems and hyperactivity, which become evident only after a few years. In addition, as adults, they are more likely to have alcohol-related problems and a predisposition to cognitive deficits.

Consuming **folic acid** is recommended right from when you start trying to get pregnant; this is a vitamin that plays a proactive role in preventing deformities related to failure to close the neural tube. Great care should be taken with **medications**, which should only be taken if prescribed by your doctor, as many are contraindicated during gestation.

As far as **nutrition** is concerned, it is generally recommended to follow the principles of the food pyramid (that is, a diet rich in fresh fruit and vegetables and low in sugars and fats), but some restrictions are recommended. In particular, it is advisable to avoid consuming raw milk-based cheeses and undercooked meat, because they can transmit serious infections (**listeriosis** and **toxoplasmosis** respectively), which can cause foetal deformities or premature births.

Some fish contain large amounts of methylmercury and dioxins. For this reason it is advisable to:

- alternate between different fish species;
- limit the consumption of swordfish, shark, salmon, and Baltic herring;
- consume a maximum of one serving per week of fresh tuna and pike.

The consumption of **game** is also to be avoided, since the high content of lead makes this type of meat potentially toxic to the baby's nervous system. The consumption of liver is also not recommended until the third month of pregnancy, as it is rich in vitamin A, which at this stage can cause deformities in the infant.

There are, however, no contraindications to **sexual intercourse** if the pregnancy follows the normal course. Sexual intercourse during pregnancy therefore depends only on the parents' desires.

As far as **physical activity** is concerned, pregnant women can continue to exercise as long as they are able to. Only disciplines involving physical contact, such as martial arts or boxing, require the mother to be particularly careful. Pregnancy is certainly not the ideal time to start a sport in order to get back in shape, but it can limit weight gain and minimise the decrease in the ability to move due to the new condition.

The average **weight gain** during pregnancy is 10 kg and depends on the woman's weight: it should be higher in underweight women and lower in over-

weight women. About 30-40% of the weight gained is due to the weight of the foetus, placenta, and amniotic fluid, while the remaining 60-70% are due to changes in the mother's body (blood, breasts etc.). Too little or too much weight gain are both related to complications during pregnancy and childbirth and the risk of obesity [**table 2**].

There is still no consensus among experts on the effects of **electromagnetic waves** during pregnancy. It is suspected that there may be negative effects, but there are currently no recommendations in this regard, except for operators working in fields particularly at risk of exposure (e.g. radiology technicians).

Finally, some studies are beginning to investigate the link between the pregnant woman's **emotional states** and the psychophysical effects on the baby in the short and long term. Becoming a mother is undoubtedly an important role change for every woman. Pregnancy has an impact on the family, social, and professional environments, giving rise to strong emotions and putting great demands on the capacity to adapt. Stress or anxiety, which produce high levels of cortisol in the mother's blood, are scientifically correlated with a decrease in birth weight and a risk of preterm delivery. In some cases, imbalances in the foetus's neuroendocrine and immune systems are also reported.

Table 2 Weight gain during pregnancy

BMI (kg/m²)*	TOTAL RECOMMENDED INCREASE (kg)
Low (<19.8)	12.8-18.0
Normal (19.8-26.0)	11.5-16.0
High (>26.0-29.0)	7.0-11.5
Obese (>29.0)	>6.0
Gestational diabetes + obesity	4-9

* BMI, Body Mass Index. This is the ratio of an individual's weight to their height squared and is used as an indicator of body composition.

THE BIRTH JOURNEY

A couple's **birth journey** is understood as the period between conception and the first few months after the birth. It cannot be viewed only as the moment of delivery itself, although this is the most defining moment. The birth is, in fact, the conclusion of a dynamic and variable journey that begins even before conception. Many factors can play an important role along the way, affecting the mode of birth itself and the health of the future mother and child.

The physiological transition from gestation to motherhood involves huge physical and emotional changes for every woman. This is a period that involves every system of the body. The experience of birth is thus one of the greatest rites of passage in a woman's life. It is also for this reason **that childbirth should not be considered an event, but a process**.

BIRTH

One cannot speak of childbirth without first having defined **labour**, a word that in itself suggests hard and arduous work. Labour is first and foremost a biological phenomenon, with which we are witnessing an important process of transformation and adaptation. The mother and child play the leading roles in this phase. Each birth will progress and unfold in a unique and unrepeatable way.

The mechanism that initiates labour is still poorly understood. Today, we know that it depends on a complex, multifactorial process that includes hormonal responses from various organs such as the placenta, the foetus's brain, and the mother's brain.

We have already seen that, in the human species, physiology typically triggers the start of childbirth between the 37th and the 41st week after the last menstruation. If this natural tendency is followed, there are fewer complications and a lower probability of having to resort to a Caesarean section.

Of the approximately 80,000 live births registered in Switzerland in 2008 (there were 86,172 in 2019):

- about 92% were born at term;

- 7.5% were preterm;
- only 0.6% of births were post-term.

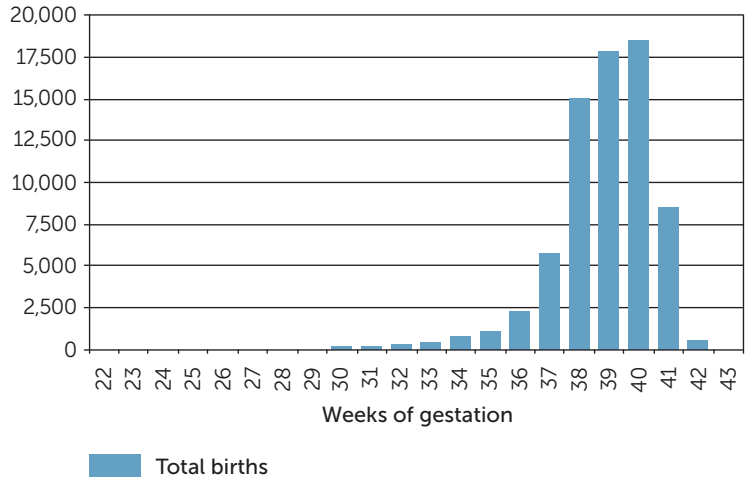
These figures [**figure 21**] are comparable to those observed in the rest of Europe.

During labour, the **uterine contractions** help to gradually open the cervix – which must reach a diameter of about 10 cm – making it softer and shorter. The contractions then help the baby descend along the vaginal canal, which has been suitably prepared already during pregnancy [**figure 22**].

Uterine contractions are different depending on the stage of labour. In fact, they are said to "mature", becoming increasingly effective, frequent, and painful over time. Paradoxically, the contractions become gradually more tolerable for the woman giving birth, thanks to the secretion of a particular category of hormones, **endorphins**.

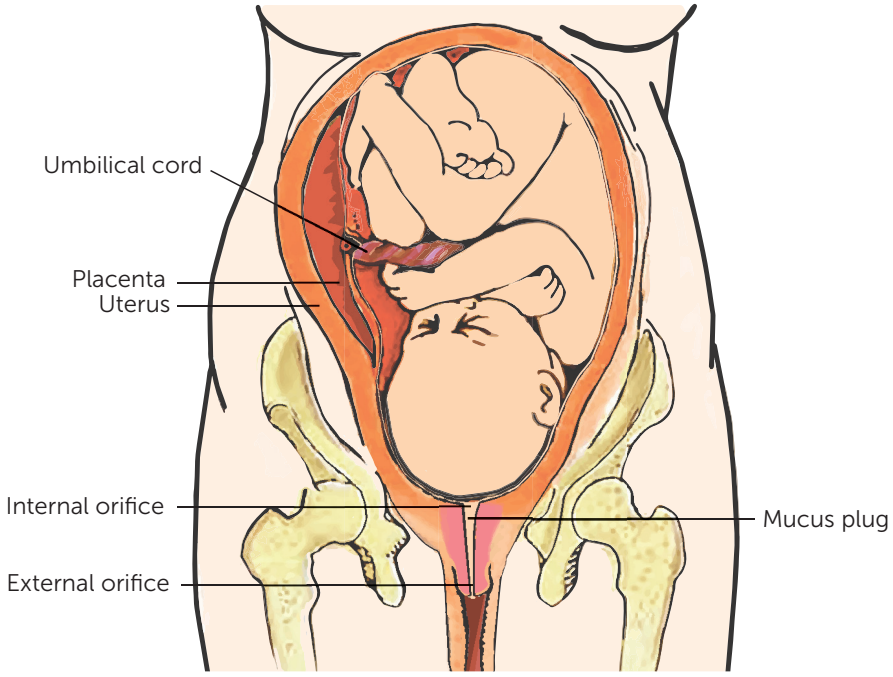
During labour, however, it is essential to alternate the phases of contraction with phases of breaks and rest that allow functional recovery and protect the well-being of the foetus and the mother.

Figure 21 Number of births in Switzerland according to gestational age. 2008 data



Source: Federal Statistical Office (FSO/OFS).

Figure 22 The birth canal



Labour can be divided into several phases [**figure 23**].

- **The prodromal period (or prodromal labour)**. The duration of this stage is extremely variable: from a few hours to several days. Contractions become increasingly regular and painful and are often interspersed with long and irregular breaks. It can be characterised by nausea and more rarely by vomiting. In this phase, the cervix dilates up to 3-4 cm.
- **The dilation phase (or first stage)**. From 3-4 cm of dilation, the cervix fully dilates to about 10 cm. The dilation of the cervix will proceed at a rate of about 1 cm/hour for the first child, while it will be faster for subsequent births.
- **The pushing phase (or second stage)**. This lasts about 1-2 hours and is characterised by intense contractions, felt as involuntary "pushes" by

the woman. The mother will be able to push actively and spontaneously to allow the baby to pass through the vagina and be born.

- **Delivering the placenta (or the third stage)**. After birth, the placenta (also known as the "afterbirth") is expelled and uterine contractility is restored.

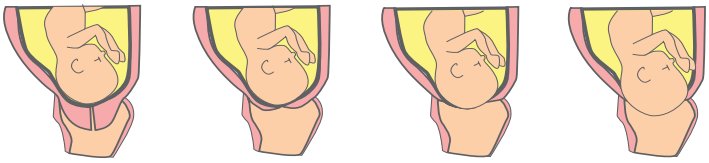
The water can break (leaking of amniotic fluid) in any of these phases or before the start of contractions. The water breaking marks the point when the foetal environment is no longer sterile. When the amniotic sac ruptures, it allows for exchange between the external environment and the uterine cavity. This is why delivery must take place in the next 24-48 hours. The rupture of the sac itself can be a factor that stimulates the onset of uterine contractions. Only some of the fluid comes out of the sac and the baby contributes to the formation of new amniotic fluid.

In very rare cases, the membranes that enclose the baby and the amniotic fluid only rupture only after birth, known as an "en caul birth". The event is so exceptional that in the past it was considered a sign of good luck.

Figure 23 The stages of childbirth

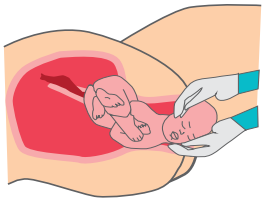
PRODROMAL PHASE The cervix dilates until the opening measures 3-4 cm.

1ST STAGE: DILATION



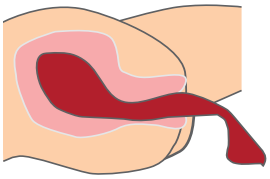
The uterine contractions cause the external orifice to dilate to 10 cm.

2ND STAGE: PUSHING



The foetus turns around and proceeds through the birth canal to the exit.

3RD STAGE: DELIVERY OF THE PLACENTA



After the baby is born, the placenta is expelled.

FALSE MYTHS ABOUT CHILDBIRTH

You have to give birth in a hospital: FALSE
In a normal pregnancy, each woman will be able to choose where she prefers to give birth.

You lose a lot of blood during childbirth: FALSE
In general, blood loss is estimated at about 500 ml. The uterus continues to contract for a while after delivery and this significantly limits the risk of excessive bleeding.

The best position to give birth is the lithotomy position (supine position, with the legs raised)**: FALSE**
Given that the position should be freely chosen by the woman, for many women the "conventional" position is actually the most painful. The position should never be fixed during labour; every woman should be able to have complete freedom of movement.

You have to cut the umbilical cord immediately after birth: TRUE/FALSE
You can wait until the placenta is detached before cutting the umbilical cord. As long as the blood circulation in the placenta is active, the baby will benefit from nutrients, oxygen, and many other important elements. This can make the incredible transition from uterine life easier for the newborn to adapt to. In certain specific cases, the cord must be cut quickly.

To be safe, childbirth must be medicalised: TRUE/FALSE
In high-risk cases, childbirth must take place in a highly medicalised and specialised setting. The same does not apply to low-risk pregnancies, which are the majority. In these cases, on the contrary, an excess of tests, analyses, and interventions, during both pregnancy and childbirth, increases the mother's levels of anxiety, which increases production of stress hormones, hindering labour and triggering various complications.

◎ WHY IS LABOUR PAINFUL?

The pain of childbirth has two origins, one in the physical area affected, the other in the brain, where the affective, emotional, instinctual, and unconscious experiences reside. Peripheral stimuli activate the central ones and together they determine the unique and personal experience of pain.

However, although childbirth is a biological event, it is strongly influenced by socio-cultural, psychological, and environmental factors. In Western culture, pain has taken on rather negative connotations and attempts are made to control it through various kinds of drugs and anaesthesia techniques.

Pain has a specific purpose and meaning in the process of birth. For example, it stimulates the brain to release hormones essential for labour itself and activates a hormonal cascade that prepares the mother to welcome the child. Pain also urges the body to move and the movement, in turn, facilitates labour.

There is therefore a reason for pain during labour, but it must remain within the range of physiological normality tolerable for the woman. Women who give birth can experience great relief through massages, assuming particular positions, using natural methods, or hot baths. This set of techniques is called **hypoanalgesia or physiological analgesia** and should be implemented with the aid of someone providing empathic, "one-to-one" support. This type of support ensures the health of the mother and the unborn child is protected as much as possible, while at the same time letting the woman **actively** make **any decisions**. The research shows that good assistance and support are the most important aspects in making childbirth a positive experience and in tolerating pain. These scientific findings mean that physiological methods are a valid alternative.

Sometimes, despite adequate assistance, the pain becomes intolerable for the woman. In this case, pain becomes "pathological" and can hinder the physiological process of childbirth. It is therefore important to combat and treat it, using pharmacological or anaesthesiological measures (for example, spasmolytics, also called antispasmodics, or epidural analgesia).

In 2018, the WHO published 56 recommendations for a positive birth experience. This document sets out the practices that should be implemented and those that should be abandoned to improve the health and well-being of the "mother-child" diad.

◎ WHAT DO WOMEN NEED DURING LABOUR?

Several hormones are actively involved throughout the birth process, from pregnancy to breastfeeding. The particular **hormonal secretions** characteristic of pregnancy lay the endocrine foundation for bonding between the mother and child. Hormonal production does not peak during pregnancy or even during childbirth, but rather when the mother holds her child.

The only thing that is really essential for childbirth is the secretion of a particular combination of hormones, the main ones being prolactin, adrenaline, endorphins, and especially oxytocin.

All the hormones necessary for the birth process are also produced outside of this extraordinary event. Oxytocin, for example, is essential to achieving an orgasm, while endorphins are also secreted during physical activity, creating a state of well-being.

Oxytocin, also called the "love hormone", is a very "shy" substance. Its secretion can be easily inhibited by numerous environmental factors that alter the levels of other hormones involved in labour, slowing down and impeding its secretion. Every woman giving birth – using only the cocktail of hormones she produces – should be in a quiet environment, with only a few, measured words spoken, and low, soft lighting. In short, an environment that guarantees intimacy, safety, and warmth. Childbirth is an involuntary process that cannot be controlled, so the only consideration is not to disrupt it.

A childbirth that is respectful of the timings and feelings of mother and child, where the woman takes a real leading role in the entire process, can take place anywhere. The only prerequisite is that it should be the mother who chooses where she feels safest: in the hospital, at home, or in a "birth centre".

When they come into the world, babies are extremely "incompetent" and would not survive on their own; however, they are well equipped with specific **relational abilities** that begin to develop in the womb. The baby's nervous, endocrine, psychological, and immune systems continue to develop through contact with its mother.

The first contact between mother and child should take place immediately after birth. The most natural thing is to put the baby in the new mother's arms

immediately, in direct skin-to-skin contact. The pair should be able to prolong this **bonding** moment undisturbed, following their instinctive needs.

It is recognised that this contact between the mother and child encompasses **biological implications** that are still partly unknown, but that go far beyond the emotional sphere alone. The possibility of influencing this biological process, promoting or hindering it, has been widely demonstrated.

In the first 60-90 minutes after birth, the newborn is in a particular state of wakefulness that makes it very receptive. It perceives everything around it: it is calm, opens its eyes and looks at its parents, smells its mother's scent, and listens to her voice. The simple maternal act of "holding" the newborn in "skin-to-skin" contact allows the infant to stabilise its body temperature and decrease its production of stress hormones. At the same time, the same behaviour allows bacteria present in the mother's vagina, anus, skin, breasts, and saliva to colonise the newborn's sterile body with familiar, compatible bacteria. This process constitutes an important protective factor for the newborn and is known as **bacterial imprinting**.

Sometimes, for various reasons, it can happen that a mother is separated from her child too early and cannot benefit from this initial contact. Fortunately, the lost time and the magic of the first few hours can be recovered. In the following days and weeks, the practice of rebonding can be used to strengthen the connection, promote mutual familiarity, and re-establish the right psychological and emotional balance that will lay the foundation for a secure attachment model.

BREASTFEEDING

"Breastfeeding is one of the most efficacious and cost-effective investments a nation can make for the health of its younger members and the future of their economies and societies." This is what UNICEF Director Anthony Lake had to say, adding: "If we do not invest in breastfeeding, we will not make progress for mothers and their children, paying a double price: in terms of loss of life and of opportunity".

Over the last thirty years, the social norms for feeding infants have fluctuated between breastfeeding and using **baby formula** and bottles. For about a decade, however, we have been witnessing a return to the promotion of breastfeeding, which requires a paradigm shift for parents and professionals. Some well-established practices need to be reviewed and challenged, such as imposing feeding times and duration, separating the mother and child, and the belief that babies should learn to lie quietly in their cribs for long periods.

In recent years, scientific research has greatly increased our knowledge of breast milk: today we know, for example, that it affects the baby's health through its microbiome. Colonisation by microorganisms already begins in the womb, proceeds during childbirth, and continues after birth with breastfeeding. The proper development of the **microbiome** plays a determining role in children's future health.

◎ CHANGES TO THE WOMAN 'S BODY

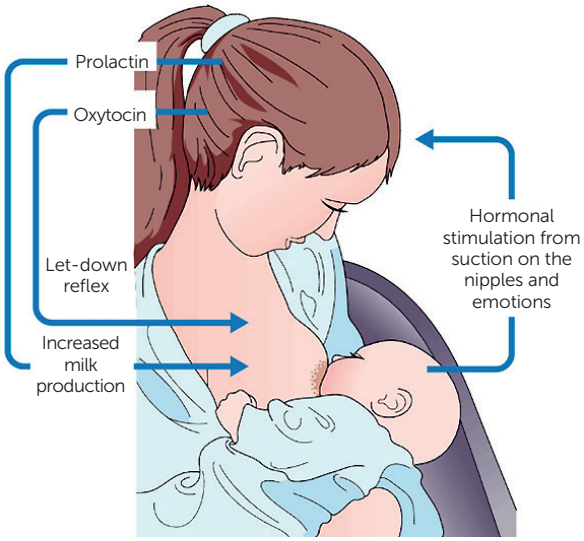
The **breasts** begin to undergo major changes during puberty and continue to change until menopause. The main anatomical structures of the breast are the **alveoli**, responsible for milk production, and the **ducts**, channels along which the milk is carried to the **nipples** to be suckled by the newborn.

The main hormones involved in breastfeeding are prolactin and oxytocin. **Prolactin** is produced by the pituitary gland and stimulates the alveoli to produce milk. To produce an adequate amount of milk, the level of prolactin in the mother's body must be high. This high concentration is achieved thanks to frequent suckling by the infant. Prolactin is also responsible for suppressing ovulation [**figure 24**].

Oxytocin, already essential for childbirth, causes the cells surrounding the alveoli to contract, allowing milk to escape from the milk ducts.

During pregnancy, the secretory tissue adapts to be ready for the birth of the baby and can be painful and tight. Some women notice a significant increase in breast size during pregnancy, others observe colostrum leaking, while others do not notice any difference. From the second half of pregnancy onwards, the level of progesterone allows an activation of the alveoli stimulated by prolactin, but morphological changes in the breast tissues do not necessarily occur.

Figure 24 Breastfeeding



STAGES OF BREASTFEEDING

Breastfeeding begins in the first hours after delivery and goes through several stages in the following days.

In the first 24 hours, the baby sleeps most of the time. Its body needs to recover and its body's systems gradually begin to work. In these very first hours of life, the baby consumes the reserves of adipose tissue accumulated during pregnancy. When suckling on its mother's breasts, it consumes small amounts of **colostrum**, a thick yellow compound. This precious "liquid gold" has a special composition that provides the baby with both energy and immune factors, essential for its immune and digestive systems in particular to adapt.

As the breasts are stimulated by the suction, milk production increases between the second and the fourth day until **the onset of lactation** begins, known as the milk "coming in". Under the influence of hormonal surges, the breasts become tight, hot, and painful. The child may have lost up to 10% of its weight and survival instinct now pushes it to latch onto the breasts very frequently. The onset of lactation lasts about 24-48 hours and often coincides with a period of transient emotional lability in the mother known as **baby blues**.

These hours of disruption are followed by a period of settling down, in which milk production stabilises according to the child's needs and for a duration that will suit both the child and the mother.

COMPOSITION OF BREAST MILK

Milk meets the environmental and biological needs of each individual species. Seal milk, for example, is very rich in fats to help them survive in very cold waters; cow's milk is particularly rich in proteins that promote the rapid growth of calves; human milk, on the other hand, is rich in lactose, a sugar that provides energy for the rapid growth and development of the brain and central nervous system.

Breast milk is highly biologically active: it contains trophic factors, antimicrobial factors, and immunomodulatory and anti-inflammatory components. It is a living biological liquid that changes its composition over time and even during a single feeding session, depending on the growth and development needs of the newborn and, subsequently, of the child [**figure 25**].

Breast milk is, therefore, the **gold standard**. Currently, no baby formula can be considered equivalent to breast milk, despite manufacturers' often misleading advertising and marketing claims [**figure 26**].

In addition to providing physical nourishment for the baby, breastfeeding also provides **emotional nourishment**. In fact, if chosen with awareness, it strength-

Figure 25 The composition of breast milk (1 drop)

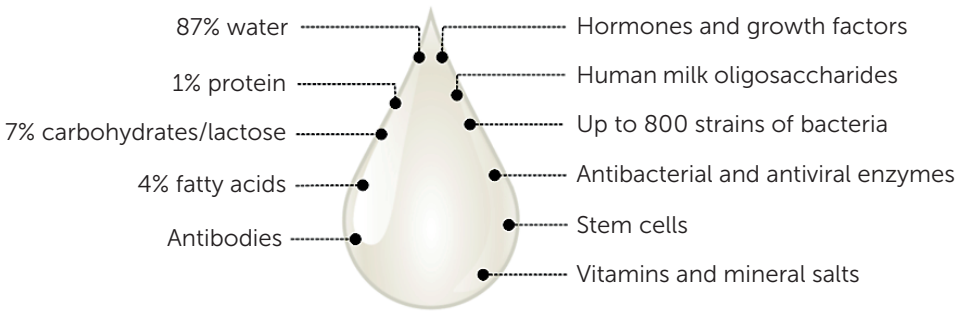
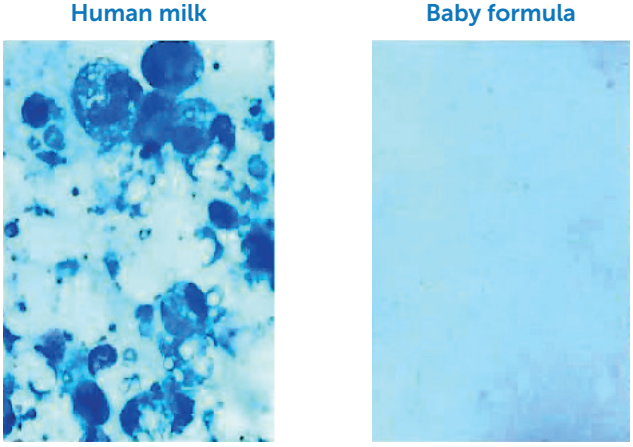


Figure 26 Differences between breast milk and baby formula under a microscope



ens the bond between the mother and child, accelerating attachment. The symbiosis of pregnancy continues even after birth.

With each feeding, the stimulation of the nipple increases the levels of oxytocin in the bodies of both mother and child, helping to establish the relationship between them. Breastfeeding thus provides reassurance to the child in moments of stress, fear, and agitation, offering a safe, warm, and comforting presence. The mother responds to the newborn's needs and they begin to communicate through eye contact and touch. This process lays the foundations for the development of future relationships. Some studies have confirmed the relationship between breastfeeding and better stress management for the rest of the child's life.

THE BENEFITS OF BREASTFEEDING

Breast milk nourishes and protects the newborn during breastfeeding, but its effects are observable in the long term, in all stages of life. Many studies show that breastfed babies are more likely to have a high IQ and have a lower risk of developing obesity, type I or II diabetes, cancer (lymphomas or leukaemias), and gastrointestinal or respiratory problems.

The longer a child receives breast milk, the greater the benefits. The World Health Organization recommends that mothers breastfeed their infants com-

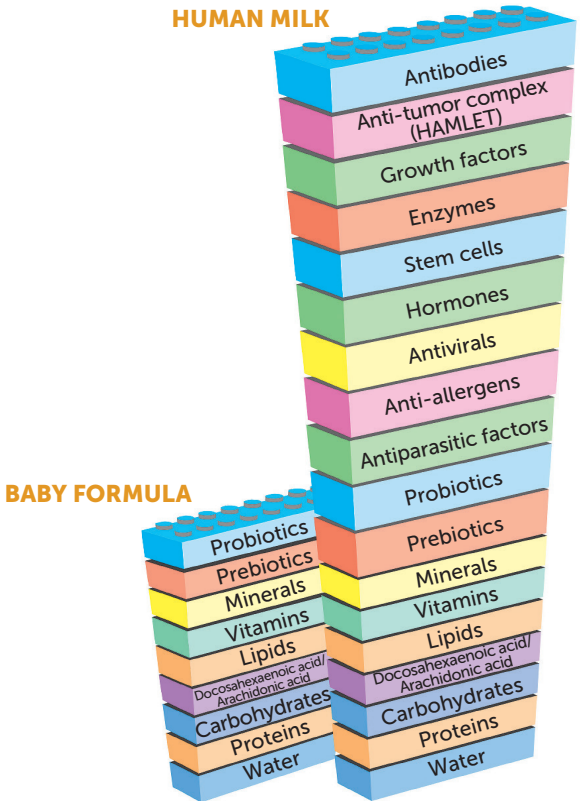
pletely up to the age of **6 months**. After that, children should be fed adequate solid foods and continue to breastfeed until they are two years of age or older.

Infants who are breastfed for the first 6 months of life are half as likely to be affected by sudden infant death syndrome (SIDS), also known as "cot death".

Breast milk **changes flavour** depending on the mother's diet, so the baby gets used to a multitude of different tastes and flavours, which is useful when the time comes for them to be weaned.

Remember that breast milk contains all the nutrients and liquids that allow the baby to grow in a well-balanced way. To compensate for the difficulties of the child's immature immune system [**figure 27**], breast milk also contains stem cells, white blood cells and antibodies, beneficial bacteria, enzymes, and hormones.

Figure 27 Differences in the composition of breast milk and baby formula



This is why it is very important that all infants are breastfed, including **premature infants**, given their fragility. These will probably not have the strength to suckle, but it is possible to temporarily extract the milk with a **breast pump** and administer it. Very often, milk production has also slowed down and, in these cases, the **milk banks** available in some regions can be used.

There are also **benefits** to deciding to breastfeed from the mother's point of view. Immediately after childbirth, when the newborn latches onto the breast for the first time, a strong dose of oxytocin is released in the mother that helps the uterus to contract vigorously, decreasing bleeding after birth. Oxytocin surges are activated whenever the baby latches onto the breast, helping the mother remain calm and relaxed and establish a stronger relationship between mother and child.

Breastfeeding also has advantages in practical and financial terms: breast milk is always available, wherever the mother is, and at no cost.

In addition, mothers who breastfeed report losing their baby weight faster than women who don't, as they burn about 500 extra calories per day. Part of this energy requirement is covered by the reserves built up by the mother during pregnancy. It is estimated that it generally takes women 6 months after giving birth to get back to their pre-pregnancy weight.

Finally, numerous studies report that breastfeeding protects women against breast or uterine cancers and osteoporosis.

FALSE MYTHS ABOUT BREASTFEEDING

Breast milk may not be nutritious enough for the baby: FALSE
Breast milk is always perfect! The composition of the milk changes even over the course of one feeding session. The "first" milk that comes out appears watery and serves to quench the baby's thirst. The "second" milk contains more fat and is therefore more nutritious and substantial.

There is an ideal breast type for breastfeeding: FALSE
There is no ideal breast type, neither in terms of shape nor in terms of size.

Breastfeeding ruins your breasts: FALSE
The breasts, like other tissues of our body, are affected by hormonal changes, such as those induced by pregnancy, and by the passage of time. Even if you choose not to breastfeed, your breasts will change in size and tone.

The baby has to eat every 4 hours: FALSE
A newborn can eat between 6 and 12 times a day in the first few months. They often concentrate many meals into a short period to then have one or two longer breaks.

You cannot take medication while breastfeeding: TRUE/FALSE
Not all medicines are indicated during breastfeeding. For this reason, it is always a good idea to ask your doctor and not to self-medicate.

You shouldn't exercise when breastfeeding: FALSE
There are no contraindications if the mother feels the need.

Breastfed babies sleep less than bottle-fed babies: TRUE/FALSE
Breast milk is rich in sugars and is assimilated by the body faster than baby formula. The different characteristics of the two types of milk partly explain the differences in the hours of sleep in newborns. However, it should not be forgotten that the number of hours of sleep needed depend on the baby from birth and are independent of how the infant is fed.

MATERNITY FROM A SOCIETAL PERSPECTIVE

Pregnancy is certainly a private matter that concerns the mother, the unborn child, the father, and the closest family members. However, it is also a societal matter, because people have rights that must be safeguarded by the states they belong to.

Let's now explore two areas: the protection of mothers at work and the laws governing the termination of pregnancies.

PROTECTION IN THE WORKPLACE

In Switzerland, as in other countries, the labour laws protect pregnant women, mothers who have recently given birth, and breastfeeding mothers from the time they become pregnant to the time they stop breastfeeding. The Swiss legislation is contained in a document that can be downloaded free of charge from the website www.seco.admin.ch, in the section "Maternità. Protezione delle lavoratrici" ("Maternity. Workers' protection").

The articles of the law **regulate the employer's obligations** with respect to the payment of wages, working hours, and, above all, working conditions. For example, a pregnant woman can take time off work to go to check-ups simply by giving notice, and she must have the opportunity to rest, lying down, when she feels the need.

Furthermore, pregnant women cannot continue to work in **areas that are potentially harmful** to pregnancy, such as work that involves contact with biological or harmful material or in sectors that require great physical exertion. If the employer cannot guarantee these conditions, the pregnant woman is exempted from work and receives 80% of her salary. Even more important is the fact that women **cannot be fired** during the entire period of pregnancy until the end of maternity leave, unless a fixed-term contract expires.

In the same way, women can **stay on leave for 14 weeks** after giving birth to take care of their child, receiving 80% of their salary. It was only very recently that Swiss women won the right to maternity leave, in 2005. Historically, marriage and the family have always been regarded as a private sphere and the state has been kept out of this specific area; the situation changed after the Second World War, when **maternity benefits** were first included in the Constitution. The final bill was approved by the Swiss people in 2004.

Unfortunately, Swiss maternity leave is one of the shortest in Europe. The legislature has recognised the importance of breastfeeding for the health of mothers and children: women who return to work and are still breastfeeding enjoy a reduction in working hours. The articles of the law in question seek to facilitate the reconciliation of breastfeeding and returning to work.

WHAT IF PREGNANCY IS NOT INDICATED? VOLUNTARY TERMINATION OF PREGNANCY

Unfortunately, the conditions aren't always right to become a parent. In some cases, pregnancy could expose the mother to both physical and mental health risks. In these cases, we are faced with difficult choices that put the mother in a position to exercise her own free will in a conscious and responsible way.

It is undoubtedly one of the most important reasons why sexuality and reproduction need to be topics that everyone is familiar with and everyone has the right to form their own opinion on. To this end, we will briefly review the events that have marked the raising of awareness and assumption of responsibility by the individual and by the State in relation to the voluntary termination of pregnancy. Putting a stop to dangerous and illegal practices represents a win for society.

Since ancient times, women have sought ways to terminate unwanted pregnancies. The use of abortifacient plants (plants that induce abortion) was well known in the past, as were other very painful methods to cause the expulsion of the foetus through mechanical stimuli of the uterus. Until the twentieth century, abortion practices were illegal and exposed both the women who resorted to them and the professionals who practiced them to significant risks.

The fight for freedom of self-determination peaked in the 1970s, in tandem with demands for the recognition of equality between men and women. Until the beginning of this millennium, however, the interruption of pregnancy was already practised by professionals in many Swiss cantons in violation of the laws in force [**figure 28** ].

In 2002, the Swiss population approved the initiative for **abortions within a time limit** and, at present, women can decide whether to maintain or terminate a pregnancy up to the 12th week of pregnancy, after attending a meeting with the Sexual Health Consultants of the Cantonal Hospital Authority (CoSS).

Drugs can be used to induce abortion up to the 7th week, after which surgery must be performed. After the 12th week, the pregnancy can only be terminated with the endorsement of a doctor and only if it poses a serious risk to the mother either physically or emotionally. In this case, the abortion is carried out by vaginal delivery.

Figure 28 Demands for freedom of abortion

CONCLUSIONS

We have come to the end of this exciting journey, during which we have got to know the secrets of the female body and its ability to procreate.

We have discovered that every woman is different and that every woman's menstrual cycle and its characteristics are unique – there is no one way to describe it, no numbers or rules that apply to everyone. But that's only the beginning.

We have seen how everything to do with conception and pregnancy is finely regulated by a network of events that interact with each other and that are mainly controlled by hormones. These substances, which are produced by the body to direct the symphony of changes, will result in the mother giving birth to her baby. The elegance, delicacy, and sensitivity of these mechanisms warrant consideration of the well-being of the mother and baby. This condition must be protected primarily through the availability of information that allows women to adopt appropriate behaviours and lifestyles.

The aspect of well-being and awareness of one's own body are among the main objectives in the field of sexual education as it relates to reproduction. To this end, we have addressed, through a series of insights, some false myths that

often contribute to establishing taboos and to handing down concepts that, in addition to being baseless, end up placing women in a state of dependence and general insecurity.

Fertilisation is the event that begins a new life. Thanks to science, this miracle is without a doubt less mysterious from a physiological point of view today than in the past. The wonder of the creation of a new life, however, remains untouched and evokes valuable feelings that have motivated and still motivate many scientists specialising in the field of development.

By studying the course of pregnancy and following the development first of the embryo and then of the foetus, we have looked at what we can expect during pregnancy, what we can see and detect, and when.

We have seen that the mother and unborn child both collaborate and at the same time compete for resources, which demonstrates how the human species has specialised over time to give each new generation the best start in life, from a biological and psychological point of view.

Again, it is important to note that nature must be supported without the individual getting caught up in selfish considerations that could end up creating more problems than they solve. This leads us to rediscover the magic of childbirth, a natural event that does not necessarily have to become a medical issue.

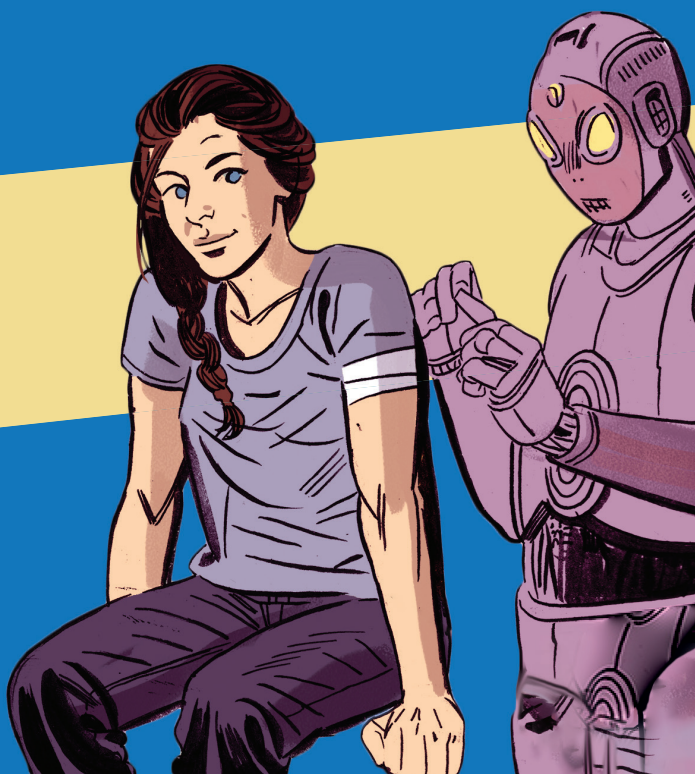
The same is true of breastfeeding, which is the first form of relationship between the newborn and the mother and should be a healthy event for both mother and child that helps establish strong bonds and the prerequisites for a healthy life characterised by well-being in the future.

Finally, we also addressed the social implications of conception and pregnancy, giving an overview of the rights won in modern societies, especially by women.

We hope we have given the reader interesting ideas to reflect on and that future generations can approach the magic of procreation in a conscious and responsible way, with particular consideration for the health and well-being of the mother and child, as well as of those who participate in these extraordinary events.

A birth in space!

PART TWO



TEXTS

By the students of class 4E of the Gravesano Middle School:

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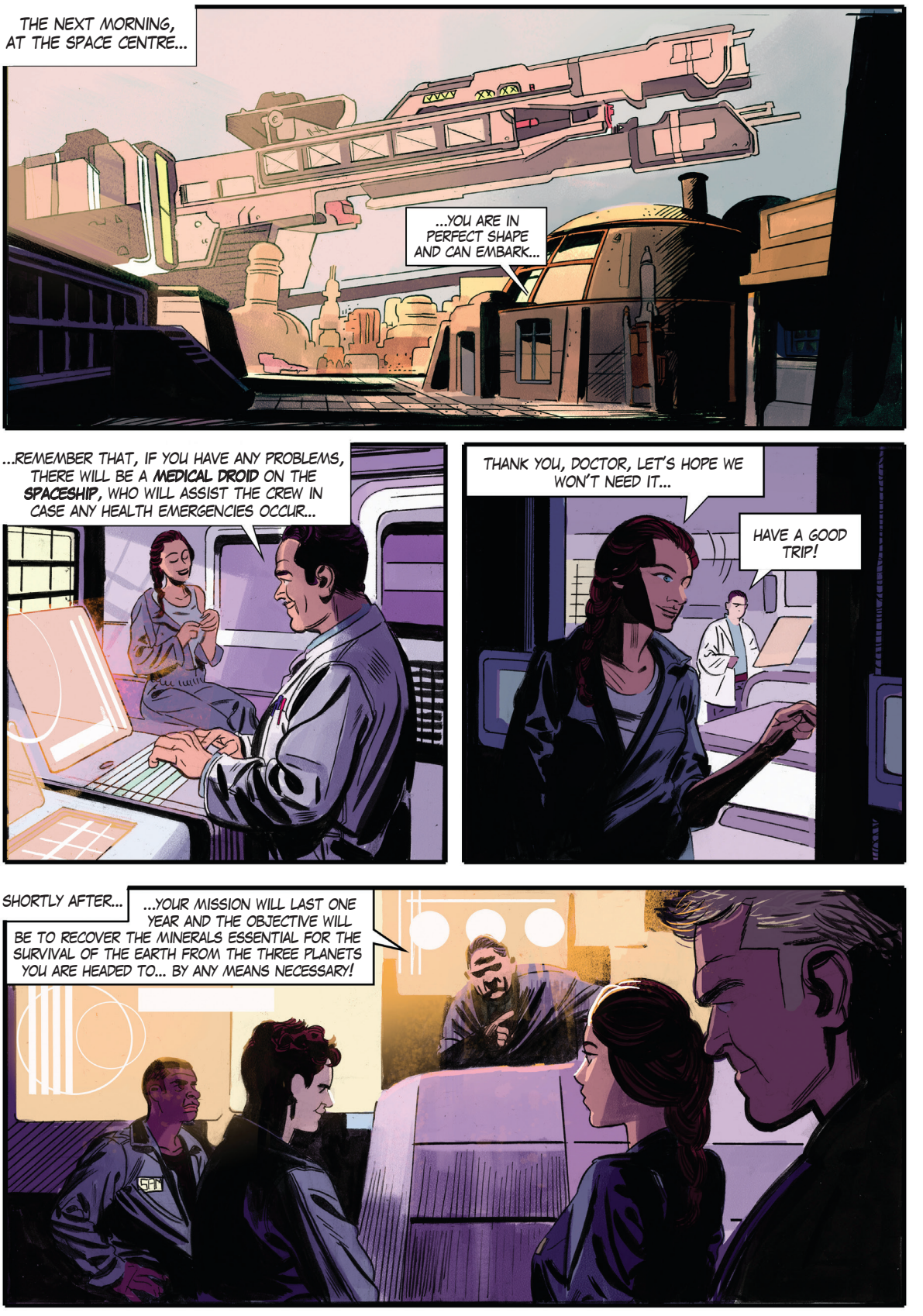
ILLUSTRATIONS

By Adriano Turtulici for the Scuola Romana dei Fumetti.

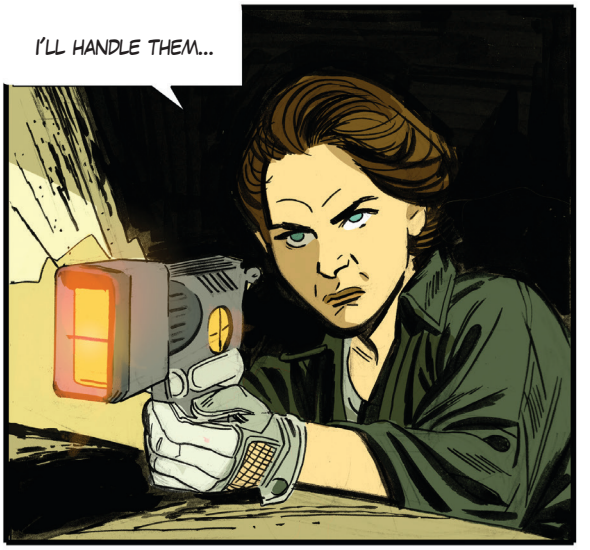

IN THE DISTANT FUTURE, ON PLANET EARTH...
I HAVE TO GO, WE WON'T SEE EACH OTHER AGAIN FOR A YEAR...
A BIRTH IN SPACE!
...SO LET'S NOT WASTE THE TIME WE HAVE LEFT, LAURA...
I LOVE YOU...

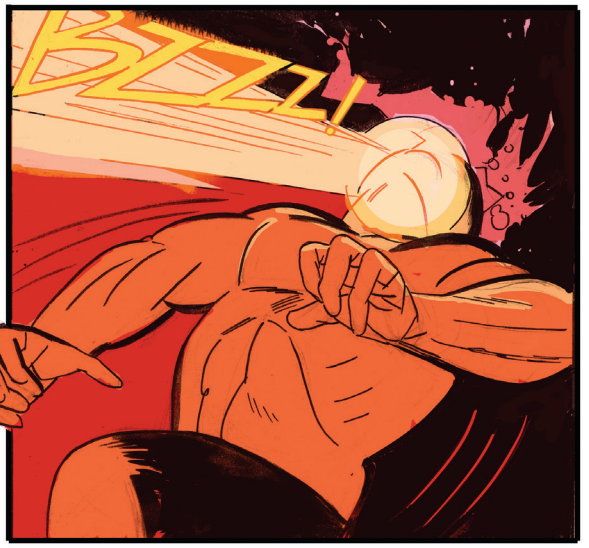

THE NEXT MORNING, AT THE SPACE CENTRE...
...YOU ARE IN PERFECT SHAPE AND CAN EMBARK...
...REMEMBER THAT, IF YOU HAVE ANY PROBLEMS, THERE WILL BE A MEDICAL DROID ON THE SPACESHIP, WHO WILL ASSIST THE CREW IN CASE ANY HEALTH EMERGENCIES OCCUR...
THANK YOU, DOCTOR, LET'S HOPE WE WON'T NEED IT...
HAVE A GOOD TRIP!
SHORTLY AFTER...
...YOUR MISSION WILL LAST ONE YEAR AND THE OBJECTIVE WILL BE TO RECOVER THE MINERALS ESSENTIAL FOR THE SURVIVAL OF THE EARTH FROM THE THREE PLANETS YOU ARE HEADED TO... BY ANY MEANS NECESSARY!

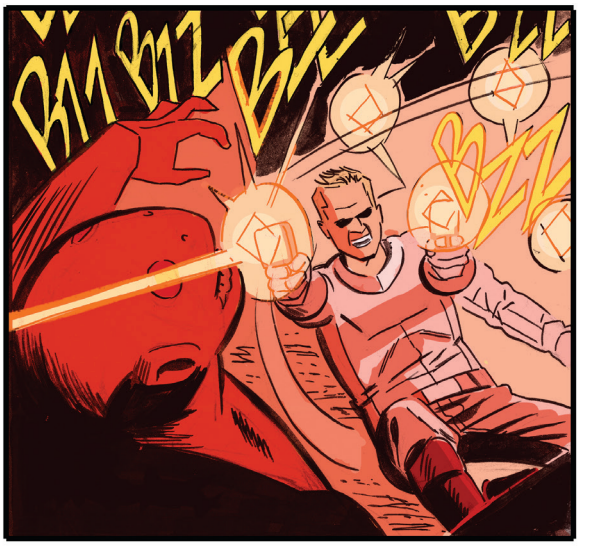

"... GOOD LUCK, LADIES AND GENTLEMEN!"
ENGINES AT FULL POWER!
VVVVRRRRRR
READY FOR TAKEOFF!...
VVVVVVVVVRRRRRRRR

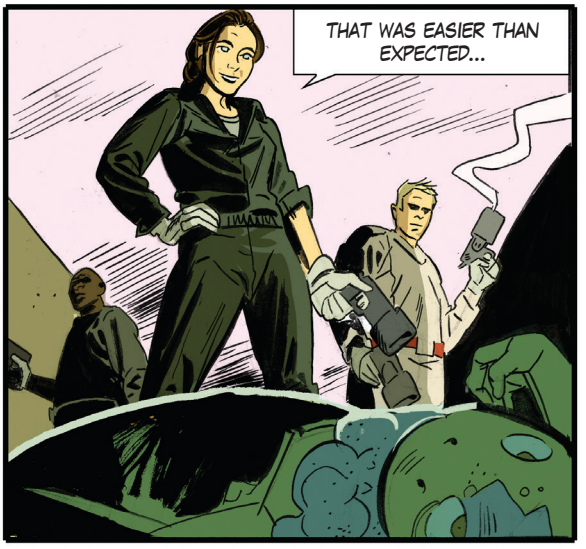

TWO MONTHS LATER, ON PLANET H24...
READY TO LAND!
FROM THE INFORMATION ON THE COMPUTER, WE SHOULD BE ABLE TO FIND THE FIRST MINERAL HERE...
...AND IT SHOULD BE IN THAT KIND OF PYRAMID STRUCTURE OVER THERE...
...LET'S GO...
...AND IF WE MEET ANY GUARDIANS, WE'LL KNOCK THEM OUT WITH THESE!


THERE'S ONLY TWO OF THEM...


I'LL HANDLE THEM...


BZZZ!


BZ1 BZ BZ


THAT WAS EASIER THAN EXPECTED...


LET'S GO IN...


KUMBLE KUMBLE KUMBLE KUMBLE
GET DOWN!
SWOOOSH
TUMP
A TRAP! THAT WAS A CLOSE CALL...
RUMBLE RUMB
LET'S BE MORE CAREFUL... THERE MIGHT BE MORE...
CLACK!


WATCH OUT!
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ
WHIZZ


AAA AHH
WHIZZ!


ARE YOU HURT?
NOTHING SERIOUS, IT JUST GRAZED ME...


LET'S CARRY ON WITH THE MISSION...

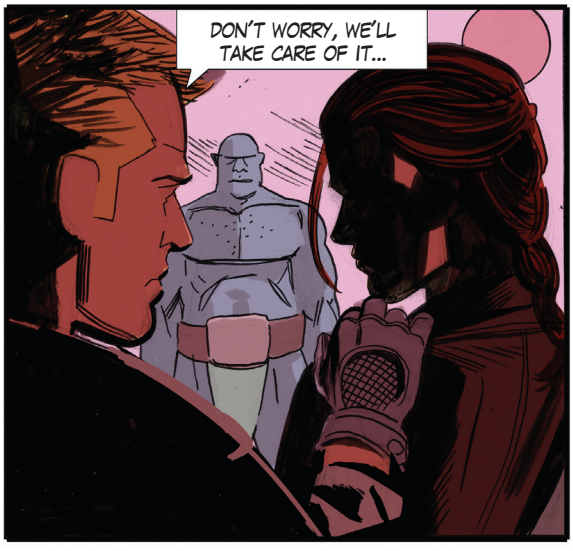

I'LL GET IT TREATED WHEN WE GET BACK TO THE SHIP...


LATER...
NOTHING SERIOUS. IT'LL HEAL SOON.
THANK YOU, DOCTOR...
MY HEAD IS SPINNING A BIT...
YOU'RE IN MILD SHOCK... YOU HUMANS ARE SENSITIVE TO FRIGHTS...
DON'T TALK NONSENSE...
SORRY...
EXACTLY...
UGHM!
THE JOURNEY CONTINUES...


SOME TIME LATER, ON THE PLANET UKG...
IF YOU DEFEAT OUR CHAMPIONS, YOU CAN HAVE THE MINERAL YOU WANT... OTHERWISE, YOU WILL DIE!

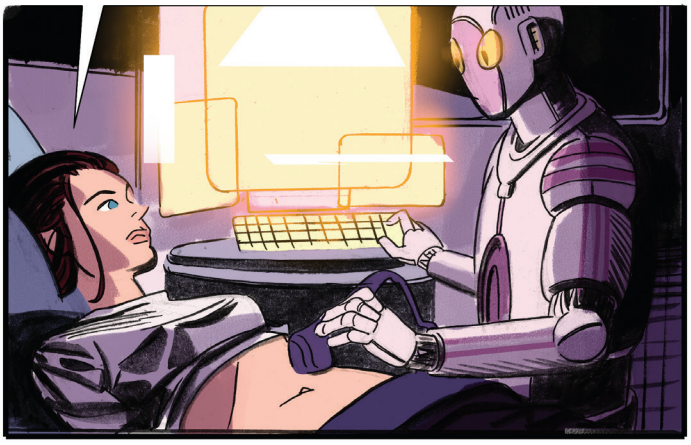

WE'RE READY!

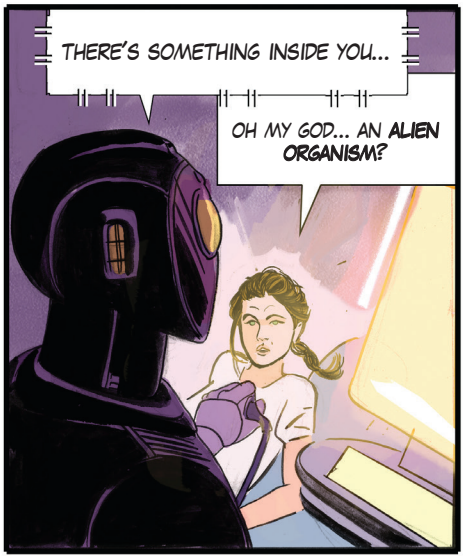

WHAT'S WRONG WITH ME? I FEEL SO STRANGE...


DON'T WORRY, WE'LL TAKE CARE OF IT...

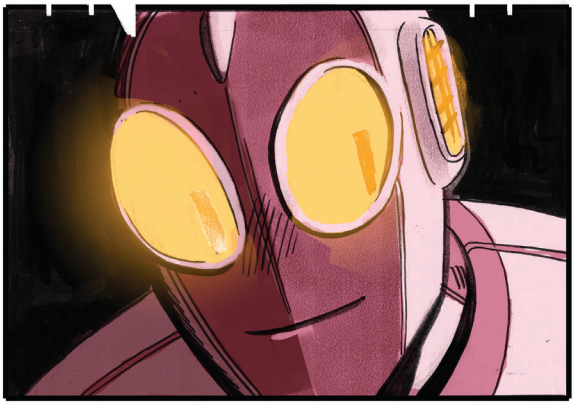

OUCH!

...AND LUCKILY, THE OTHERS MANAGED WITHOUT ME... I'VE NEVER HAD TO BACK OUT OF A FIGHT BEFORE... WHAT'S WRONG WITH ME, DOCTOR? IS IT SERIOUS?

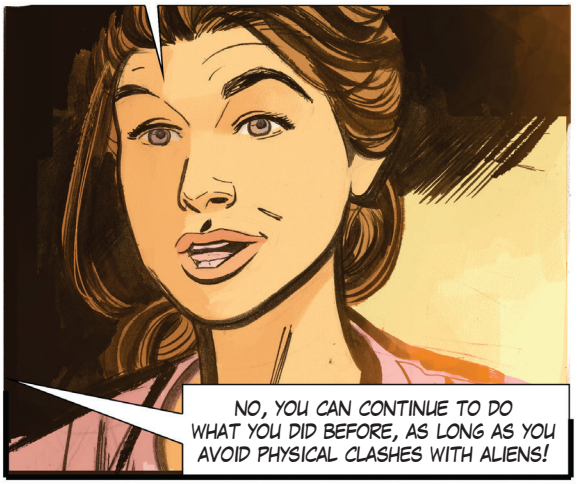




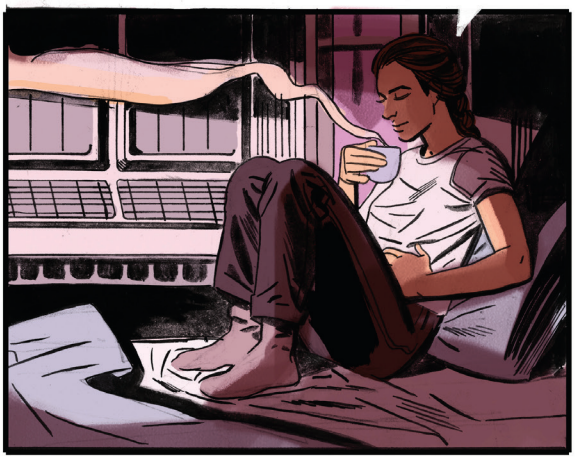
NO, YOU'RE JUST **PREGNANT!** SYMPTOMS SUCH AS VOMITING ARE A SIGN OF THE NEW HORMONAL MAKEUP IN YOUR BODY, WHICH IS GROWING NEW STRUCTURES TO ALLOW FOR THE DEVELOPMENT OF A NEW LIFE...



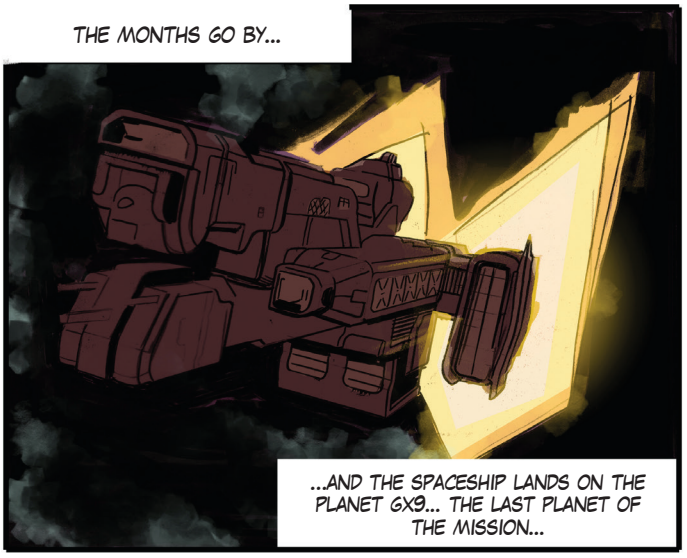
I'M EXPECTING A BABY... BUT WILL THAT COMPROMISE MY MISSION?



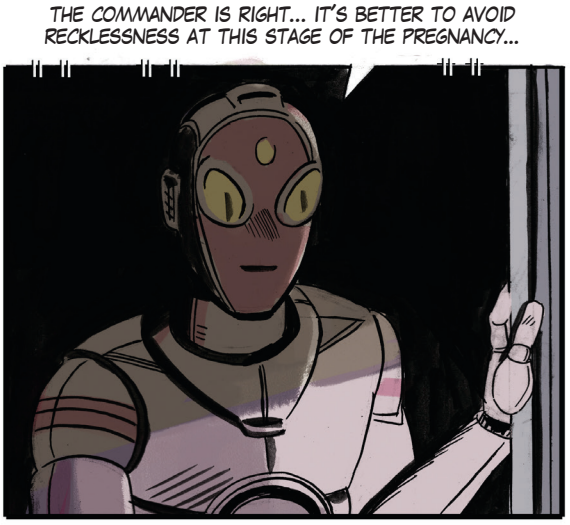
A SON... BUT IS IT SAFE FOR HIM TO BE BORN IN SPACE? AND WILL HE BE ABLE TO GROW PROPERLY WITH THE SHIP'S PROVISIONS?



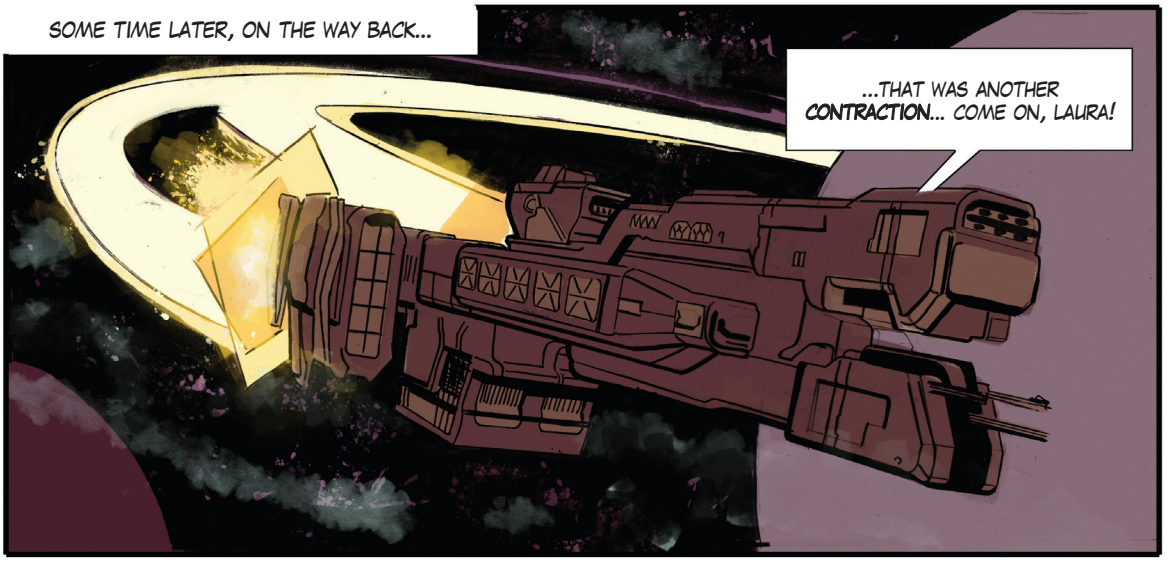
I WONDER WHAT YOUR FATHER WILL DO WHEN HE SEES YOU...


THE MONTHS GO BY...
...AND THE SPACESHIP LANDS ON THE PLANET GX9... THE LAST PLANET OF THE MISSION...


YOU'D BETTER STAY ON BOARD, WE'LL KEEP IN RADIO CONTACT...
BUT I FEEL PERFECTLY FINE, FULL OF ENERGY...


THE COMMANDER IS RIGHT... IT'S BETTER TO AVOID RECKLESSNESS AT THIS STAGE OF THE PREGNANCY...


HE JUST KICKED... I THINK HE AGREES WITH YOU TOO!


SOME TIME LATER, ON THE WAY BACK...
...THAT WAS ANOTHER **CONTRACTION**... COME ON, LAURA!


LAURA... I CAN SEE HIS HEAD COMING OUT... YOU'RE NEARLY THERE... I KNOW YOU'RE TIRED BUT I ALSO KNOW YOU STILL HAVE THE STRENGTH YOU NEED... IT'S COMING OUT...
I CAN'T DO IT...
YES I CAN... I'M STRONG AND I CAN DO IT... FOR HIM, FOR ME... I HAVE TO DO IT!
NGUEEE!
WELCOME, MY LITTLE ONE...
SIGH
THEN, AS SOON AS THEY ARE BACK ON EARTH... LAURA AND THE BABY GET A VISIT FROM THE MIDWIFE...
THEY ARE BOTH DOING GREAT... MUM IS RECOVERING AND THE BABY IS IN PERFECT HEALTH...
BY THE WAY, WHAT'S THE LITTLE CHAP'S NAME?
WE DON'T KNOW YET!

THE END

Acrosome The anterior part of the head of the spermatozoon; it releases enzymes that allow the sperm cytoplasm to penetrate the egg cell. The spermatozoon consists of the head and a flagellum, which enables motility in the female genitalia after ejaculation.

Amniocentesis An invasive procedure that is performed between the 16th and 18th weeks of pregnancy for the purpose of prenatal diagnosis. It consists of the trans-abdominal collection of a sample of amniotic fluid, containing foetal cells, in order to analyse them and look for the most common genetic abnormalities.

Bacterial imprinting The mechanism by which the bacteria present in the mother's vagina, anus, skin, breasts, and saliva come into contact with the sterile body of the newborn and colonise it with familiar and compatible bacteria. It is an important protective factor for the newborn.

Bonding The process of forming a deep connection between mother and child in the first few hours after birth.

Cerebral synapse	A communication structure that allows nerve impulses to be transmitted between neurons or from a neuron to another human cell. There are electrical synapses, which essentially enable "reflex-like" responses, and chemical synapses, which offer more ways to modulate the message transmitted.
Chorionic villi	The foetus is protected during pregnancy by the chorion, which is composed of cells that are genetically identical to the foetus. Some of these cells, called chorionic villi, extend to the placenta.
Corpus luteum	A temporary endocrine gland that produces progesterone and, in smaller amounts, oestrogens. It is formed on fertile days during the luteal phase. It self-destructs if the woman does not conceive.
Crossing over	A recombination mechanism of homologous chromosomes to ensure greater genetic variability.
Endometriosis	A disease caused by the presence of endometrial tissue outside the uterine cavity; this condition causes chronic inflammation.
Endometrium	The mucosa covering the inner wall of the uterus. Its thickness and vascularisation change during the three phases of the ovarian cycle and it is the tissue where the embryo implants. It is involved in the formation of the placenta.
Endorphins	Hormones produced by the brain that have a powerful analgesic effect and create a general sense of well-being.
Enzyme	A substance that facilitates reactions in the human body, such as digestion or cell fusion. In many cases, human functions are regulated by a chain of enzymatic reactions, i.e. various enzymes act in a coordinated manner for each phase of the process in progress.
Fallopian tubes	Even, symmetrical tubular organs that connect the ovaries to the uterine cavity.

Fimbriae	Fingerlike projections that make up the distal part of the Fallopian tubes. Under the influence of hormones, the fimbriae move, creating ascending currents that guide the ovum released from the follicle inside the tubes.
Gametes	The spermatozoon and the oocyte. They are formed through a process called gametogenesis, or more specifically, spermatogenesis in men and ovogenesis in women. The gametes are haploid.
Gastrulation	The process of embryonic development that occurs from the 3rd week of pregnancy onwards: the cells are increasingly differentiated from each other and the three layers (the ectoderm, endoderm, and mesoderm) are formed in the embryo, from which all the tissues of the body originate.
Gold standard	A common phrase used in medicine to indicate the best choice.
Gonads	Sexual organs that produce gametes. In the female reproductive system they are called ovaries and produce oocytes. The testicles located in the scrotum are the male gonads and produce sperm. Their functioning is regulated by the hypothalamic-pituitary axis, but they also secrete their own hormones, which means they are also endocrine glands and an active part of the same axis. The testicles produce androgens, especially testosterone, which are responsible for the development and expression of male characteristics.
Hirsutism	Increased and ectopic hair growth in women.
Hormone	A chemical messenger produced by endocrine glands that targets multiple organs.
Hypoanalgesia	Also called physiological analgesia, this is a set of natural techniques (massages, assuming particular positions, using natural means, hot baths) that offer relief to the mother during labour. Professional and individualised (one-to-one) assistance is particularly effective.

Hypothalamus An endocrine gland located at the base of the brain, whose activity is strongly linked to the pituitary gland – likewise in the brain – and to the ovaries. The interaction between the three glands is called the hypothalamic-pituitary axis. The hypothalamus stimulates the functioning of the pituitary gland through gonadotropin-releasing hormone (GnRH). Under the influence of GnRH, the pituitary gland secretes the gonadotropins FSH and LH, which regulate the functioning of the ovaries, into the bloodstream. The ovaries in turn modulate the hormonal activity of the hypothalamus through concentrations of oestrogen and progesterone in the blood. The hypothalamus also produces two hormones that are released into the blood from the pituitary gland: vasopressin and oxytocin. Oxytocin is essential for uterine contractions during childbirth and for stimulating the mammary glands during breastfeeding. The hypothalamus also synthesises the precursor of prolactin, dopamine.

Menopause The phase of a woman's life that coincides with the end of fertility. It occurs when menstruation stops, usually between the ages of 45 and 55.

Morula One of the early stages of embryo development. It is composed of an aggregate of cells (blastomeres) that form during zygote division. It has a cluster-like shape similar to a small blackberry.

Myometrium The muscular layer of the uterine wall responsible for contractions during labour. Its activity is regulated by progesterone and oxytocin.

Oestrogens and progesterone The main female hormones produced by the ovaries. They are the main drivers of the development of female secondary sexual characteristics, such as the breasts. Changes in plasma concentrations of these two hormones are responsible for many important human processes, such as changes in the uterine endometrium or the inhibition of uterine contractions during pregnancy.

Organogenesis	The phase of embryonic development that begins after gastrulation. The final tissues and organs are formed during this process and the growth of the embryo's body is determined.
Ovarian follicle	Follicles are the structures that contain oocytes. They go through different stages of maturation: the primordial follicles form during the foetal period; from puberty onwards, they undergo structural changes until they reach maturation a few hours before ovulation, which leads to the release of the ovum from the follicle and the ovary.
Oxytocin	Also known as the "love hormone", it is produced by the posterior pituitary gland (or neurohypophysis), which acts mainly on the breasts and uterus. It is particularly important during labour and delivery because it causes uterine contractions, aiding the expulsion of the foetus.
Placenta	A temporary organ of the female reproductive system. It is made up of both foetal tissues (chorionic villi) and maternal tissues (the endometrium) and acts as a barrier between the amniotic environment of the foetus and the environment of the uterine cavity. Exchanges between the foetus and the mother take place through this organ: maternal and foetal blood each flow in closed circuits, but the blood vessels are so close to each other that they allow the direct passage of nutrients, oxygen, and waste products between the mother and the foetus and vice versa.
Pneumocytes	Cells that make up the epithelium of the pulmonary alveoli.
Polar body	This is formed during ovogenesis which, unlike spermatogenesis, is a reductive process. In fact, the meiotic divisions result in a single egg cell. The "waste" genetic material is eliminated by means of polar bodies, which are expelled and are not able to be fertilised.
Prolactin	An essential hormone for lactation, produced by the pituitary gland.

Pulmonary alveolus	A functional unit of the lung, responsible for gas exchange.
Sperm capacitation	The process of sperm maturation that gives it the capacity to fertilise. Capacitation takes place in the passage of the female genital tract.
Surfactant	This is produced by type 2 pneumocytes and is a compound of proteins, phospholipids, and cholesterol. Its main role, indispensable for lung function, is to keep the pulmonary alveoli open after the first exhalations and to facilitate gas exchange. It is produced from the 30th week of pregnancy onwards.
Yolk sac	An anatomical formation that provides the nutrients necessary for the development of the embryo until the placenta forms. It is the first element of the gestational sac that can be seen on an ultrasound.
Zona pellucida	A membrane that surrounds the ovum and contains specific receptors for sperm cells; also called the egg coat or pellucid zone.
Zygote	A fertilised egg cell that results from the union and fusion of the male and female gametes in sexual reproduction.

In this booklet, the authors accompany us on an exciting journey through the secrets of the female body and its ability to procreate: from the menstrual cycle to conception, from birth to breastfeeding.

But this book is not meant to be a treatise on sexuality and reproduction. Instead, the aim is to tackle important issues by focusing on the individual and emphasising "well-being" during a period full of changes and new discoveries. This new perspective should also apply to women carrying a new life and to those who support them on this extraordinary journey. The hope is that knowledge and responsibility can finally be shared within the couple.

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Inside the comic:

A birth in space!

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