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BALLITO

ASHTON INTERNATIONAL COLLEGE BALLITO
SENIOR COLLEGE TRIAL EXAMINATIONS TERM 3
CASE STUDY AND ESSAY BASED ASSESSMENT PII
FORM 5 IEB LIFE SCIENCES
04 SEPTEMBER 2024

SOURCE MATERIAL BOOKLET FOR
QUESTIONS 1, 2 AND 3

NAME	
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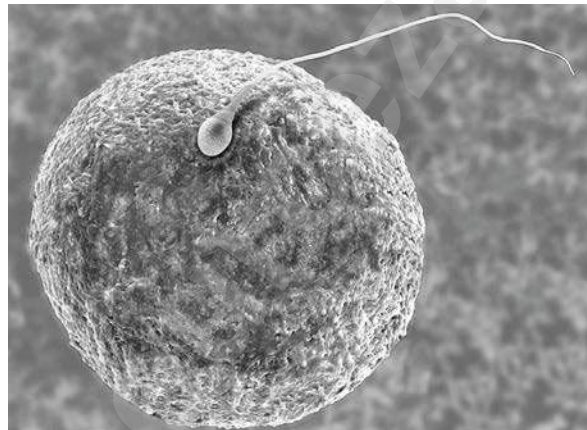
SECTION A**QUESTION 1**

Read the information below. Use this information, as well as your own knowledge to answer Question 1 in the question paper.

Past, present, and future of birth control

When a single sperm penetrates an ovum a zygote is formed. After many divisions of the zygote by mitosis, a small ball of cells is formed. Once implantation of this ball of cells occurs, a pregnancy results. Despite the United Nation's statement that contraception is a basic human right, every year there are more than 200 million unwanted pregnancies worldwide. Human fertility is therefore both a blessing and a curse: for many, it can lead to poverty and suffering, which is why humans have long searched for an effective method of contraception that would enable them to take control of their fertility and decide if, when, and how often they become pregnant.

Figure 1 – Photo of human ovum with sperm cell placed on it



Magnification: egg 260X, sperm 760X.

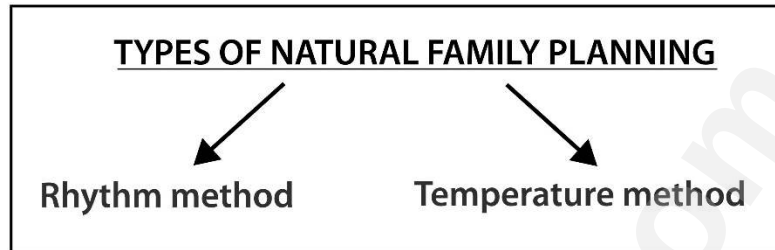
[Adapted: <<https://images.fineartamerica.com>>]

People have tried very hard to understand women's fertility and human reproduction. It's not entirely surprising that only a few worked out exactly what sex had to do with pregnancy – scientists didn't identify sperm until 1678. It took another 100 years to work out the function of sperm. Mammalian ova weren't identified until 1827 by Karl Ernst von Baer. It was another 103 years until Herman Knaus in Austria and Kyusaku Ogino in Japan were able to work out the timing of ovulation in women. Physiologists only demonstrated in the 1970s when, in the menstrual cycle, fertilisation of the ovum was most likely.

[Adapted: <<https://www.mayoclinic.org>>]

Contraceptive methods – natural family planning methods

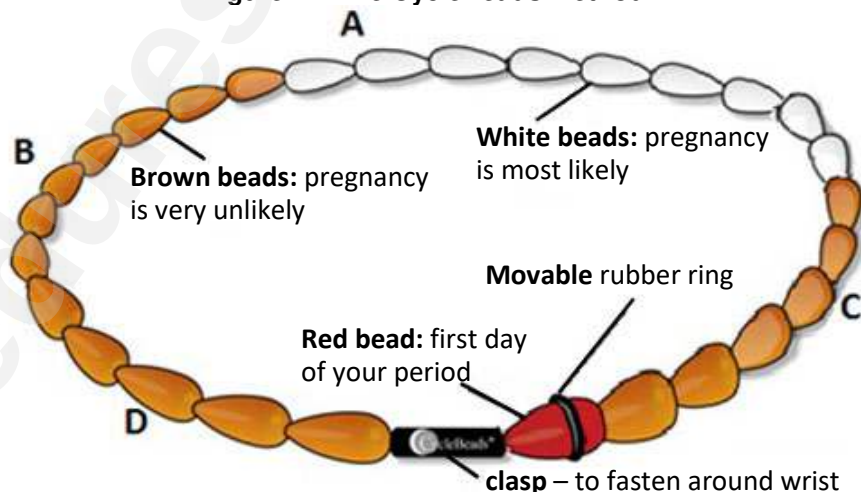
Avoiding intercourse at certain times has been used as a birth control method ever since it was first discovered that sexual intercourse led to pregnancy. (In ancient India it was thought sex must be avoided during menstruation as it was believed that babies were formed when menstrual blood combined with men's semen!)



The **temperature method** of birth control uses the fact that a woman's body temperature changes throughout the menstrual cycle. The process of ovulation takes about 24 hours. Once the ovum is in the Fallopian tubes, it only stays alive for about 24 – 48 hours. After ovulation has occurred, the body temperature rises and stays higher until menstrual bleeding begins. Therefore, by monitoring her body temperature throughout her menstrual cycle, a woman can be relatively certain that she is not fertile if her body temperature has increased and has remained higher for at least two days.

CycleBeads, developed by the Institute for Reproductive Health at Georgetown University in the USA, are a colour-coded string of beads (that may be worn as a bracelet) that represent the days of a woman's menstrual cycle. It is used to keep track of her menstrual cycle and assist her in using the rhythm method of contraception. Starting on the first day of her period, a band or rubber ring is put around the red bead. Every day thereafter, the band is moved clockwise to the next bead. The colour of the bead lets her know if she is highly likely to be fertile on that day. With correct use, CycleBeads are 95% effective at preventing pregnancy.

Figure 2 – The CycleBeads Method

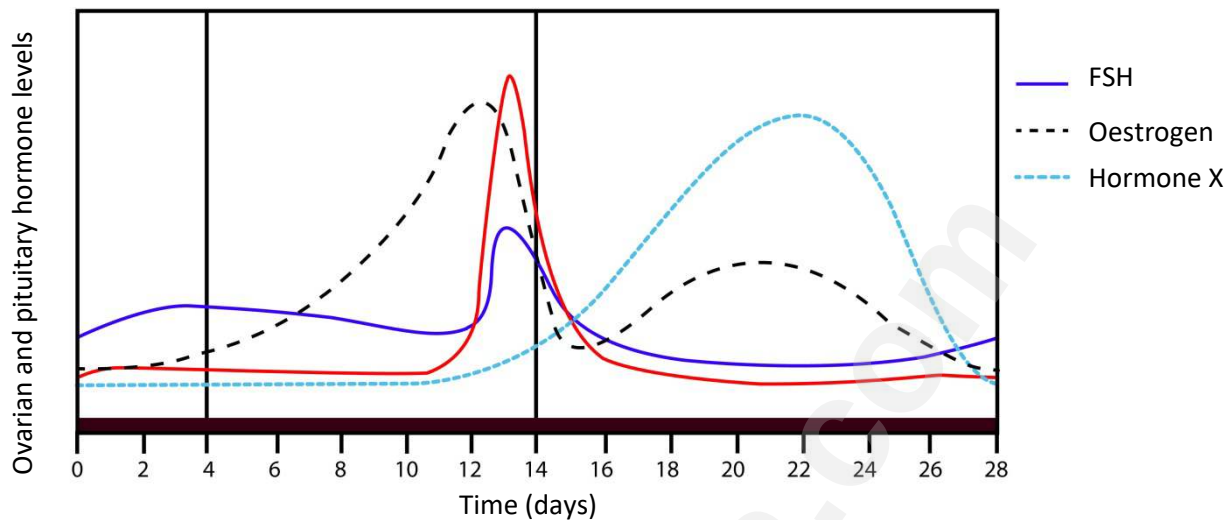


INSTRUCTIONS FOR USE:

- On the first day of your period, move the ring to the red bead.
- Mark this date on your calendar.
- Every morning move the ring to the next bead. Always move the ring from the wider to the narrower end of the bead (i.e. clockwise in the diagram.)

[Adapted: Are'valo, M., Jennings, V. & Sinai, I. 2002. Efficacy of a new method of family planning: the StandardDays Method. *Contraception* 65: 333 – 338.] [Adapted: <<https://www.psi.org>>]

Figure 3 – Menstrual cycle graph showing hormone levels



[Adapted: <britannica.com>]

[Adapted: Burroughs, V. L. & Burroughs, B. 1990. *Contraception: A Guide to Birth Control Methods*. Prometheus Books. Buffalo, NY][Adapted: Grimes, D. Gallo, M. Grigoreiva, V. 2005. Fertility-awareness based methods for contraception: Systematic review of randomised controlled trials. *Contraception*. 2005(72):85-90.][Adapted: <<https://www.plannedparenthood.org>>]

Chemical contraception

Intra Uterine Devices (IUDs)

The first specifically designed IUD was made in 1909. There are two types of IUDs: a copper IUD, first produced in 1969, that does not release hormones, and a plastic IUD introduced in 1996, that releases controlled doses of hormones.

Mirena is a brand-name IUD that releases high levels of an artificial form of the hormone progesterone. The Mirena is used to prevent pregnancy and can be used to reduce the thickness of the endometrium and therefore prevent heavy menstrual bleeding in women. The Mirena contains 52 mg of artificial progesterone and is set to release 0,02 mg of the hormone per day. Mirena is 99% effective in preventing pregnancy.



Figure 4 – Mirena IUD

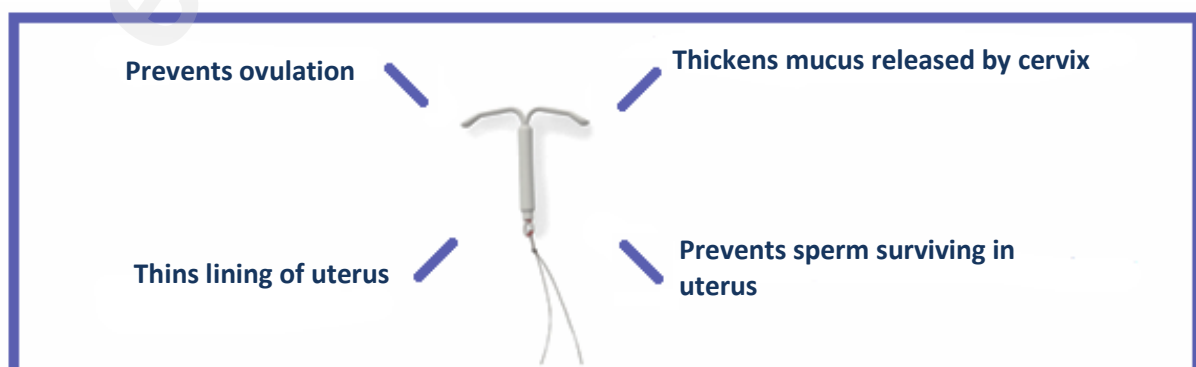
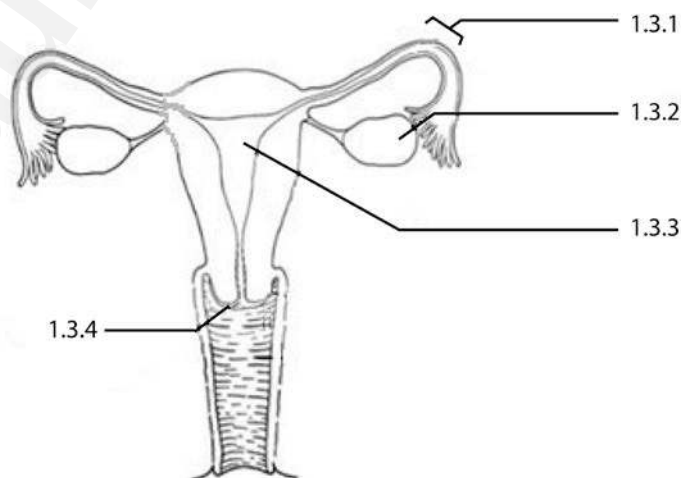
[Adapted: <<https://www.floridainjurylawyer-blog.com>>]Functions of an IUD. [Adapted: <<https://www.bedsider.org>>][Adapted: <<https://www.healthline.com>>] [Adapted: <<https://www.plannedparenthood.org>>]

Table showing other types of contraception

Contraceptive type	Description	
1. Barrier methods		
Female condom	Sheath placed into the vagina that blocks semen entry and prevents pregnancy and STD infection. Easy to use and readily available.	Figure 5 – Female Condom  [Adapted: < https://www.menafn.com.com >]
Diaphragm	Rubber cap placed over entrance to cervix to prevent semen entering uterus. Different sizes exist – therefore women must be measured by a doctor for correct size. Can lead to bladder infections. May be uncomfortable to use. Does not protect against STDs.	Figure 6 – Different types of diaphragm  [Adapted: < https://encrypted-tbn0.gstatic.com >]
2. Hormonal method		
Contraceptive pill	Oestrogen and/or progesterone pills – prevent production of ova and therefore ovulation; thickens cervical mucus. Allows complete control of contraception by woman.	Figure 7 – Contraceptive pills  [Adapted: < https://wikipedia.com >]

[Adapted: Grimes, D. A, ed. 1992. Highlights from an International Symposium on IUDs.

The Contraception Report 3(3): 4.] [Adapted: <<https://www.fpa.org.uk>>][Adapted: <<https://www.webmd.com>>][Adapted: <<https://www.urologyhealth.org>>]**Figure 8 – Diagram showing a longitudinal section through the female reproductive system**[Adapted: <<https://o.quizlet.com>>]

QUESTION 2

Read the information below. Use this information, as well as your own knowledge to answer Question 2 in the question paper.

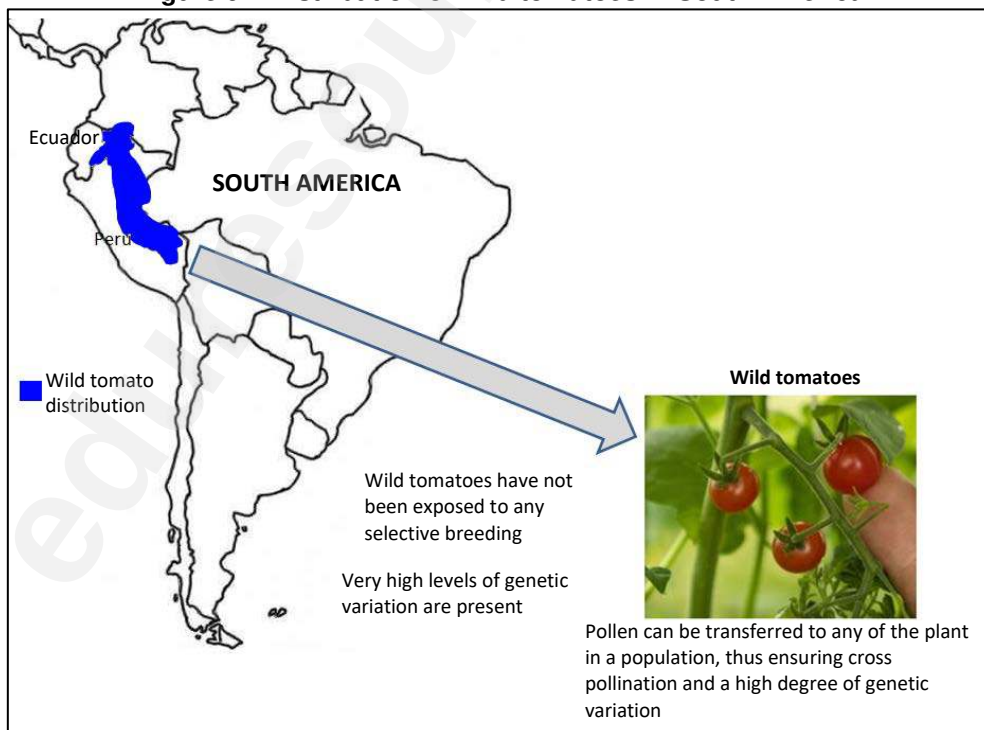
Growing the best tomatoes

The majority of crops and vegetables that we currently eat were selectively bred from their original wild ancestors within the past 12 000 years. This ultimately led to the accumulation of valuable combinations of alleles. However, unfavourable alleles were also inherited and accumulated through this process, such as those causing susceptibility to certain diseases.

Climate change is accelerating issues regarding food production. One of the consequences of climate change is a shift in the areas where pests and diseases can occur. This means that plants are exposed to new diseases and pests that never previously affected them. Therefore, if farmers keep cultivating the same varieties in the same place, yields can decrease. Plant breeders have realised the problem also exists in other varieties of crop plants, such as tomatoes, that have also been produced in this way. They have tried to re-introduce variation in alleles by crossing the crop species with a wild relative. For example, rice yields in Asia were hit by the "*rice grassy stunt virus*" in the 1970s. Resistant varieties to this virus were then created by crossing modern rice with a wild relative.

Wild tomatoes, which are native to the Andes region in South America, produce pea-sized fruits. The early indigenous peoples such as the Aztecs and Incans started changing the plant characteristics from around AD 700 by selecting mutants with desirable traits, such as larger fruit, for breeding purposes.

Figure 9 – Distribution of wild tomatoes in South America



[Adapted: <<https://www.worldatlas.com>>; <<https://www.ag.umass.edu>>]

Worldwide tomato production has increased by 300% since 1980 to over 182 million tons per year, worth around R1,32 trillion per year. Global production is expected to continue increasing in the future.

[Adapted: The world's leading producers of tomatoes. *Worldatlas*]
Adapted: Zsögön, A., Čermák, T., Naves, E. 2018. *De novo* domestication of wild tomato using genome editing. *Nat. Biotechnol.* 36, 1211–1216]

In order to preserve the alleles from wild tomatoes, their seeds are being collected from the isolated regions of South America. The seeds are now being sent to breeding organisations around the world. Some are being stored in seed banks such as the C. M. Rick Tomato Genetics Resource Centre at the University of California, Davis. The Centre has seeds from more than 3 800 specimens. This includes both wild tomatoes, as well as seeds from modern tomato varieties.

[Adapted: <<https://www.tgrc.ucdavis.edu>>]

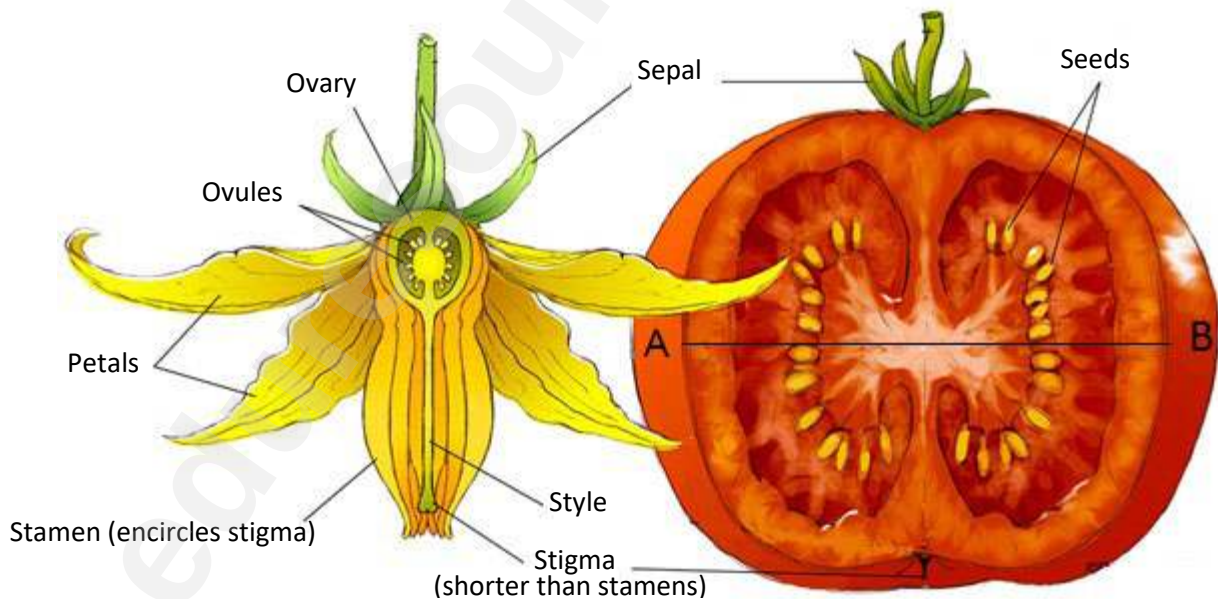
Figure 10 – Interior of a seed vault (e.g. this one is the Svalbard Global Seed Vault in the Arctic)



[From: <<https://www.dw8stlw9qt0iz>>]

[Adapted: <<https://www.newscientist.com>>]

Figure 11 – Flower and fruit of tomato plant



[Adapted: <<https://www.carlsonstockart.com>>]

Modern hybrids vs. Heirloom varieties

The varieties of tomato that exist today can be divided into two different types – modern hybrids and heirloom varieties.

These have been developed in different ways as shown in the infographics below:

A: Heirloom varieties:

Heirloom varieties (an heirloom is something that is passed down from ancestors)	
1. Before industrialisation of agriculture, farmers grew food on small, often isolated farms	 [<https://www.fleetfarm.com>]
2. Every year, cross pollination between the same crop plants naturally tended to occur using pollen from nearby plants	
3. Farmers can keep seeds from the best plants for future planting every year	
	6. The crop is relatively uniform in appearance and characteristics, but there could be differences in size/quality between them
	5. These varieties are obviously well suited to the area where they were bred
	4. Therefore each area of farmers tended to produce a variety of plant that was particular to a certain group of farms

In order to achieve consistency of fruit, agriculture in the modern world consists of large areas where only a few varieties of each crop are grown, therefore many of these smaller heirloom varieties have died out – leading to a 75% decrease in crop genetic diversity in modern varieties.

B: Modern hybrid varieties:

Modern hybrid varieties		
1. Breeders self-pollinate plants containing a set of favourable characteristics, collect seeds, plant them and repeat the process over many generations to produce a pure-bred plant. This is referred to as 'parent 1'. This process is repeated with plants containing another set of different favourable characteristics to produce 'parent 2'.	 [<https://www.dayliliesinaustralia.com>]	4. New plants are called F1 hybrids. They contain favourable characteristics from each parent (e.g. insect resistance) and are identical to one another. Farmers cannot keep seeds from the plants as there is no guarantee that they will contain the favourable characteristics. They have to buy new seeds each season.
2. Pollen is taken from parent 1 and placed onto the stigma of parent 2. (Self pollination, as well as cross pollination from unwanted plants must be avoided in the process.)		3. Seeds are collected and planted.

Figure 12 – A blossom bag used in the cultivation of hybrid tomatoes



Bag covers flowers after pollination has been performed in step 2 between Parent 1 and Parent 2.

[<<https://www.livingseeds.co.za>>]

Figure 13 – 'Rocky'* F1 hybrid tomato seed pack

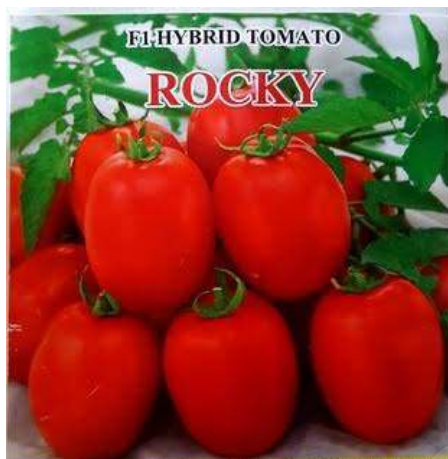
[<https://www.aliababa.com>>]

Figure 14 – Three types of heirloom tomato



Costaluto Genovese*

Big Rainbow*

Brandywine*

[<https://qohshorticulture.weebly.com>>; <<https://www.livingseeds.co.za>>]

(* these are the names of different tomato varieties)

In the future, tomato production will involve attempting to propagate plants **asexually** using techniques such as tissue culture, as well as genetic manipulation, to improve characteristics such as flavour, colour, and nutrient content.

[Adapted: <<https://stanfordmag.org>>]

[Opeña, R. T., Chen, J. T., Kalb, T & Hanson, P. 2010. Hybrid seed production in tomato]

[Adapted: <International Cooperator's AVDRC Guide. Suggested cultural practices for tomato. 2001>]

[Adapted: What are F1 plants and seeds: How and why of F1 hybrids. <<https://www.allotment-garden.org>>][Adapted: Bai, Y. & Lindhout, P. 2007. Domestication and breeding of tomatoes: What have we gained and what can we gain in the future? *Annals of Botany* 100(5): 1085 – 1094]

Polyploidy and tomato hormones

Israeli scientists have identified a polyploid tomato amongst a crop of natural diploid individuals. The fruits were found to be 50% larger than in the diploid plants. They also contained more juice and were seedless. The lack of seeds is unfortunate for plant growers, as it would be an advantage for farmers to be able to grow these plants commercially.

Auxins are a class of natural plant hormones that occur in shoot and root tips where they promote mitosis and therefore stem and root growth. Auxins can be utilised by plant growers as they cause cell differentiation (specialisation) when applied to undifferentiated stem cells of plants.

[Adapted: Kagan-Zur, V., Yaron-Miron, D. & Y. Mizrahi. 2011. A study of triploid tomato fruit attributes. *Journal of the American Society of Horticultural Science*. 116(2):228–231.]

[Adapted: The Institute for Agriculture and Applied Biology, Ben-Gurion University of the Negev.]

SECTION B

Read the information below. Use this information as well as your own knowledge to answer Question 3 in the question paper.

QUESTION 3**SOURCE A****What is a Caesarean section?**

Caesarean delivery (C-section) is a surgical procedure used to deliver a baby through incisions in the abdomen and uterus.

A C-section might be planned ahead of time if you develop pregnancy complications or you've had a previous C-section and aren't considering a vaginal birth after caesarean (VBAC). Often, however, the need for a first-time C-section doesn't become obvious until labour is underway.

If you're pregnant, knowing what to expect during a C-section — both during the procedure and afterward — can help you prepare.

Source: <https://www.mayoclinic.org/tests-procedures/c-section/about/pac-20393655>

SOURCE B**Summary**

Results from observational studies suggest that caesarean-section delivery may reduce the risk of mother-to-child transmission of HIV-1 infection in comparison with vaginal delivery. Scientists carried out a randomised clinical trial to address this issue and to assess the extent of postdelivery complications.

Methods

Women who were between 34 and 36 weeks pregnant, with a confirmed diagnosis of HIV, and without any other indications that a caesarean section will be necessary were selected for this study. Women were randomly assigned elective caesarean-section delivery at 38 weeks of pregnancy or vaginal delivery. An infant was classified as uninfected if he or she became negative for antibody to HIV-1 by age 18 months or tested negative for the virus by on at least two occasions, with no clinical, immunological, or viral evidence of infection. From 1993, to March, 1998, 436 women were randomised.

* **elective caesarean** – caesarean section planned ahead of time.

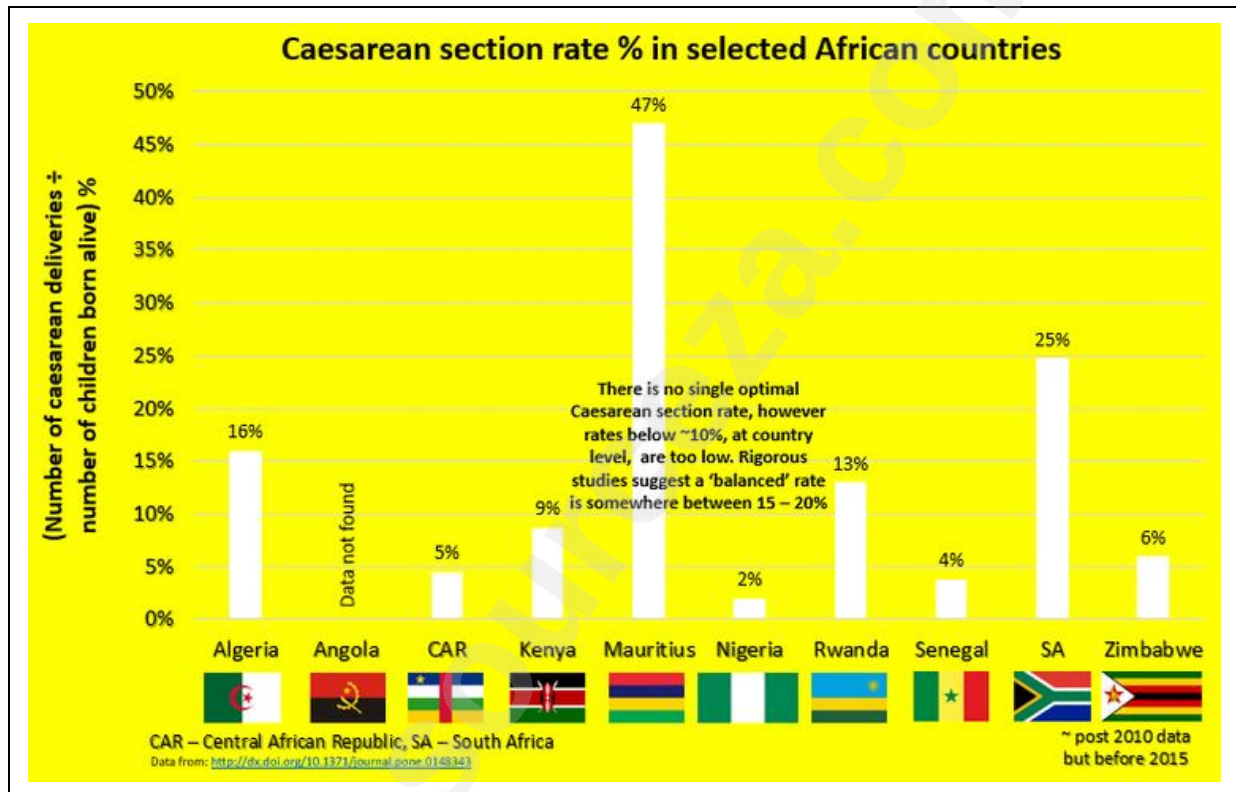
Findings

Scientists present the results of an analysis updated to November, 1998, with data on the infection status of 370 infants. Three (1.8%) of 170 infants born to women assigned caesarean-section delivery were infected, compared with 21 (10.5%) of 200 born to women assigned vaginal delivery. Seven (3.4%) of 203 infants of women who actually gave birth by caesarean section were infected compared with 15 (10.2%) of 167 born vaginally. There were few complications after delivery and no serious adverse events in either group.

Interpretation

Their findings provide evidence that elective caesarean-section delivery significantly lowers the risk of mother-to-child transmission of HIV-1 infection without a significantly increased risk of complications for the mother.

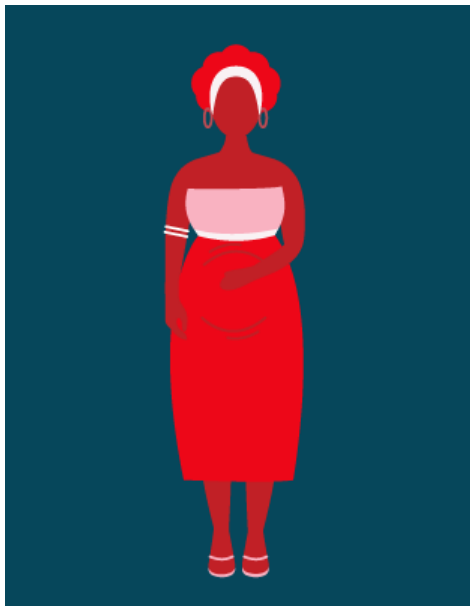
Source: [https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736\(98\)08084-2.pdf](https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(98)08084-2.pdf)

SOURCE C**SOURCE D**

CAESAREAN BIRTHS		NATURAL BIRTHS
28 326 (74%)	deliveries	9 698 (26%)
R1.2bn	paid for births	R238 mil
3.75	in hospital on average (days)	2.64
R43 226	average cost per delivery	R24 568

Source: <https://www.businessinsider.co.za/discovery-c-sections-natural-births-2019-4>

SOURCE E



AVERT.org
Taking treatment properly during pregnancy and breastfeeding will keep your baby free of HIV.

FAST FACTS

- A pregnant woman living with HIV can pass on the virus to her baby during pregnancy, childbirth and through breastfeeding.
- If you are a woman living with HIV, taking antiretroviral treatment correctly during pregnancy and breastfeeding can virtually eliminate the risk of passing on the virus to your baby.
- Attending antenatal appointments means you can get tested for HIV and if needed receive treatment and medical advice to help keep you and your baby healthy.

How is HIV transmitted from mother to child during pregnancy?

If you are a pregnant woman living with HIV there are a number of ways that HIV might be passed on to your baby. HIV in your blood could pass into your baby's body. This is most likely to happen in the last few weeks of pregnancy, during labour, or delivery. Breastfeeding your baby can also transmit HIV, because HIV is in your breastmilk. There is a 15 to 45% chance of passing HIV on to your baby if neither of you take HIV treatment. However, taking the correct treatment during your pregnancy and while you breastfeed can virtually eliminate this risk.

How can I prevent passing HIV on to my baby?

If your HIV test result is positive, there are a number of things you can do to reduce the risk of passing on HIV to your baby.

Taking antiretroviral treatment to protect your baby

Taking treatment properly can reduce the risk of your baby being born with HIV to less than 1%.

If you knew that you were HIV-positive before you got pregnant, you may be taking treatment already. If you are not, talk to a healthcare professional about starting treatment as soon as possible.

If you found out that you living with HIV during your pregnancy, it is recommended that you start treatment as soon as possible and continue taking it every day for life.

Your baby will also be given treatment for four to six weeks after they are born to help prevent an HIV infection developing.

Protecting your baby during childbirth

If you take your treatment correctly, it will lower the amount of HIV in your body. In some people, the amount of HIV in their body can be reduced to such low levels that it is said to be 'undetectable' (undetectable viral load).

This means that you can plan to have a vaginal delivery because the risk of passing on HIV to your baby during childbirth will be extremely small.

If you don't have an undetectable viral load, you may be offered a caesarean section, as this carries a smaller risk of passing HIV to your baby than a vaginal delivery.

Source: <https://www.avert.org/hiv-transmission-prevention/pregnancy-childbirth-breastfeeding>

SOURCE F

Vaginal birth vs Caesarean section

Pros and cons for mothers and babies

VAGINAL DELIVERY

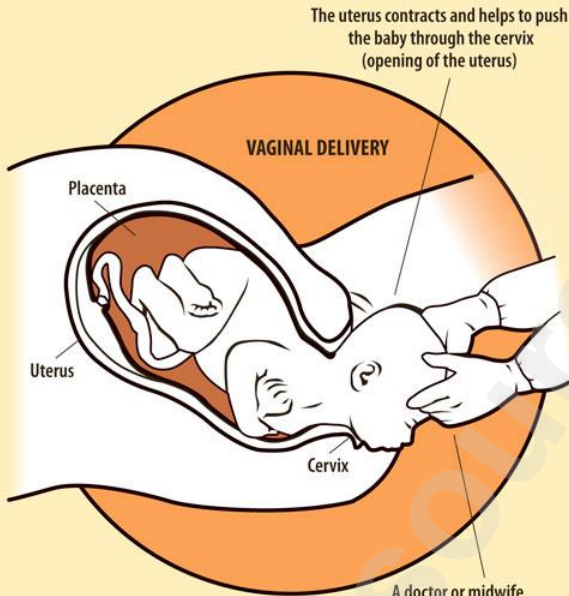
✓ Pros

MOTHERS

- 1 Mothers have quicker recovery times and shorter hospital stays
- 2 They breastfeed earlier and start bonding with the baby sooner

BABIES

- 1 By coming through the birth canal, babies have a "natural" physiological adaptation to the external environment, which results in a stronger immune system
- 2 Babies are less likely to have allergies and breathing problems



✗ Cons

MOTHERS

- 1 Women may have difficulty controlling their bladder or bowels after giving birth
- 2 They may also experience lingering pain in the perineum, the area between the vagina and the anus

BABIES

- 1 Newborn babies may experience asphyxia, when the baby is deprived of oxygen, which can cause suffocation, organ damage or death from a delayed delivery
- 2 There are higher possibilities of mothers transmitting viruses such as the human papillomavirus (HPV), the hepatitis B virus and other sexually transmitted viruses and bacteria

CAESAREAN SECTION

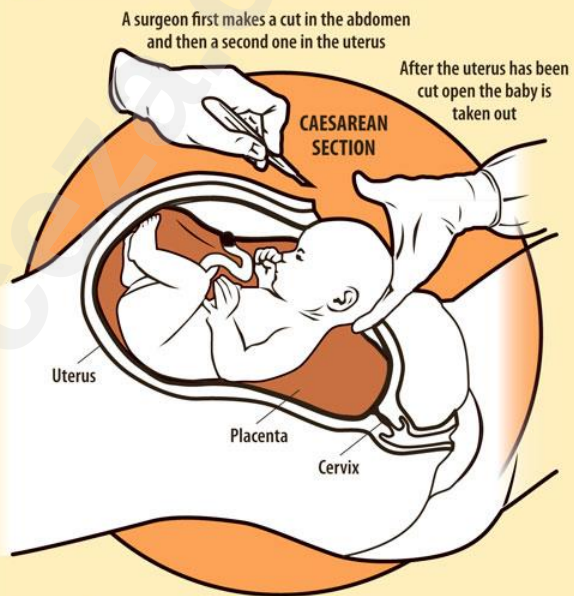
✓ Pros

MOTHERS

- 1 Women can plan when they give birth and control the pain experienced to a great extent
- 2 Women who have Caesarean sections are less likely to have urinary incontinence (the loss of bladder control)

BABIES

- 1 HIV-positive mothers are less likely to pass on the virus to their babies
- 2 Babies are less likely to experience birth trauma, such as not getting enough oxygen



✗ Cons

MOTHERS

- 1 A Caesarean section is major surgery so recovery time is longer, which extends a mother's stay in hospital
- 2 There is a risk of uterine rupture. Most women's bodies can't sustain an endless number of Caesarean sections, so C-sections often limit the number of children a woman can have

BABIES

- 1 Babies born by elective C-sections are more likely to develop breathing problems such as abnormally fast breathing during the first few days after birth
- 2 Surgical injuries are rare, but accidental cuts to the baby's skin can occur during delivery

Graphic: JOHN McCANN Compiled by: PONTSHO PILANE
Data source: THE AMERICAN JOURNAL OF PERINATOLOGY, MAYO CLINIC

Source: <https://bhekisisa.org/article/2016-11-25-the-pros-and-cons-of-c-sections-and-vaginal-births/>