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NICHE SCHOOLS PRELIM EXAMINATIONS
AUGUST 2024

LIFE SCIENCES PAPER 2
SOURCE BOOKLET

Time: 2 hours

100 marks

STUDENT NAME AND SURNAME: _____

THIS PAPER CONSISTS OF 13 PAGES

SECTION A**QUESTION 1**

The following sources refer to various animal reproductive strategies. Read the source and answer Question 1.

Reproductive habits of ruffed lemurs.

Ruffed lemurs are diurnal and arboreal quadrupeds, often observed leaping through the upper canopy of the seasonal tropical rainforests in eastern Madagascar. They are also the most frugivorous of the Malagasy lemurs, and they are very sensitive to habitat disturbance. Ruffed lemurs live in multi-male/ multi-female groups and have a complex and flexible social structure, described as fission-fusion. Such communities are dispersed core social groups that interact with other core groups in the community but break into small subgroups during mating and gestation. They are highly vocal and have loud, raucous calls.

Ruffed lemurs are seasonal breeders and highly unusual in their reproductive strategy. They are considered an “evolutionary enigma” in that they are the largest of the extant species in the Lemuridae, yet exhibit reproductive traits more common in small, nocturnal lemurs, such as the short gestation period (102 days) and relatively large average litter sizes (2-3). Ruffed lemurs also build nests for their newborns (the only primates that do so), carry them by mouth, and exhibit an absentee parental system by stashing them in trees while they forage. Infants are helpless at birth, although they develop relatively quickly, travelling independently in the wild after 70 days and attaining full adult size by six months.

[Source: Red ruffed lemur species factsheet. ©Durrell Wildlife Conservation Trust, July 2006]

Reproductive habits in amphibians and reptiles.

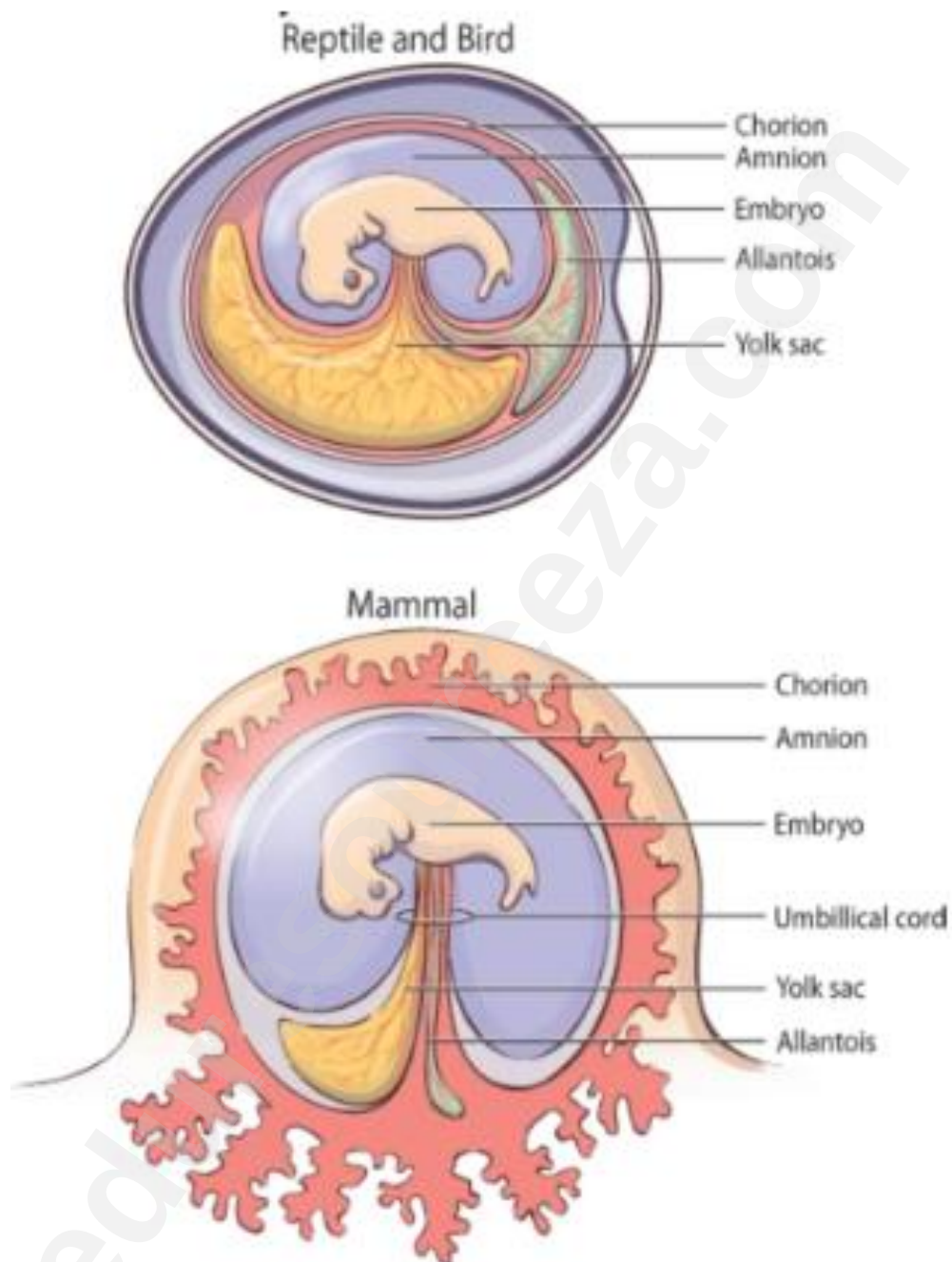
Although fish, amphibians and reptiles all lay eggs, amphibians differ from reptiles and mammals in their reproductive strategy. Reptiles, birds and mammals are called amniotes due to distinct features of the embryo's development inside an egg or inside the mother's uterus.

A. Frog eggs with growing embryos.

[Source:<https://www.woodlandtrust.org.uk/blog/2019/04/>.]

Frogs can breed from between two and three years old. They often return to the pond where they spawned, and males attract females by croaking. Breeding involves the male attaching himself to the back of the female by grasping her under the forelegs, where he stays until she lays her eggs. As the females lay spawn, the males fertilise it by spraying sperm over them. It is possible for more than one male to fertilise a female's spawn.

Females lay their spawn in well-vegetated, shaded, shallow ponds. As the eggs mature, the clusters of spawn swell and float to the water's surface. There may be so many clusters in a pond that they merge to look like one jelly mat.

B. Amniotic egg bird and reptile; mammalian embryo.

[Source: <https://www.woodlandtrust.org.uk/blog/2019/04/>.]

Environmental cued hatching in reptiles.

There is evidence for the widespread occurrence of environmentally cued hatching (ECH) in animals. There are three types of ECH in reptiles: early hatching, delayed hatching, and synchronous hatching; ECH is currently known from 43 species, including turtles, crocodilians, lizards, snakes, tuatara, and worm lizards. Early hatching caused by physical disturbance (e.g. vibrations) is the most reported ECH across all groups. Delayed hatching, characterized by metabolic depression or embryonic aestivation, sometimes followed by hypoxic cue (flooding), occurs in some turtles and possibly in monitor lizards and crocodilians. Synchronous hatching, whereby sibling eggs hatch at the same time despite differing temperatures in the nest, occurs in some turtles and crocodilians.

Rising temperatures could spell trouble for animals that use temperature-dependent sex determination (TSD). This is when an animal's gender is controlled by the temperature that an animal is exposed to while it is developing as an embryo or larva. Sea turtles are one group of animals that are subject to TSD. During the reproductive season, female sea turtles come ashore to bury their eggs in the sand. The temperature of the sand determines whether the clutch is born male or female. For most turtles, low temperatures result in an all-male clutch, while high temperatures result in an all-female clutch. Because of this, scientists have expressed fears that a rise in global temperatures could affect male/female ratios of turtle hatchings, causing devastating losses to turtle populations.



[Source: <https://www.carbonbrief.org/in-depth-how-will-climate-change-affect-animal-sex-ratios>]

QUESTION 2

Read the following sources referring to hormones in humans and use the information to answer Question 2.

In a study published in *Child Development*, researchers studied the sleep habits of 3,120 high school students. They then compared sleep habits to mood, school performance, and behavior. They found that struggling students went to bed 40 minutes later and had 25 fewer minutes of sleep than the students earning better grades. The students who got less sleep also experienced increased sleepiness during the day, depressed mood, and behavior problems. Studies have also shown that shorter sleep duration in children and teens increases the risk of them being overweight and obese.

Graphs showing the release of growth hormone into the body over a 24-hour period (starting 8 am) in a normal individual and a person with acromegaly.

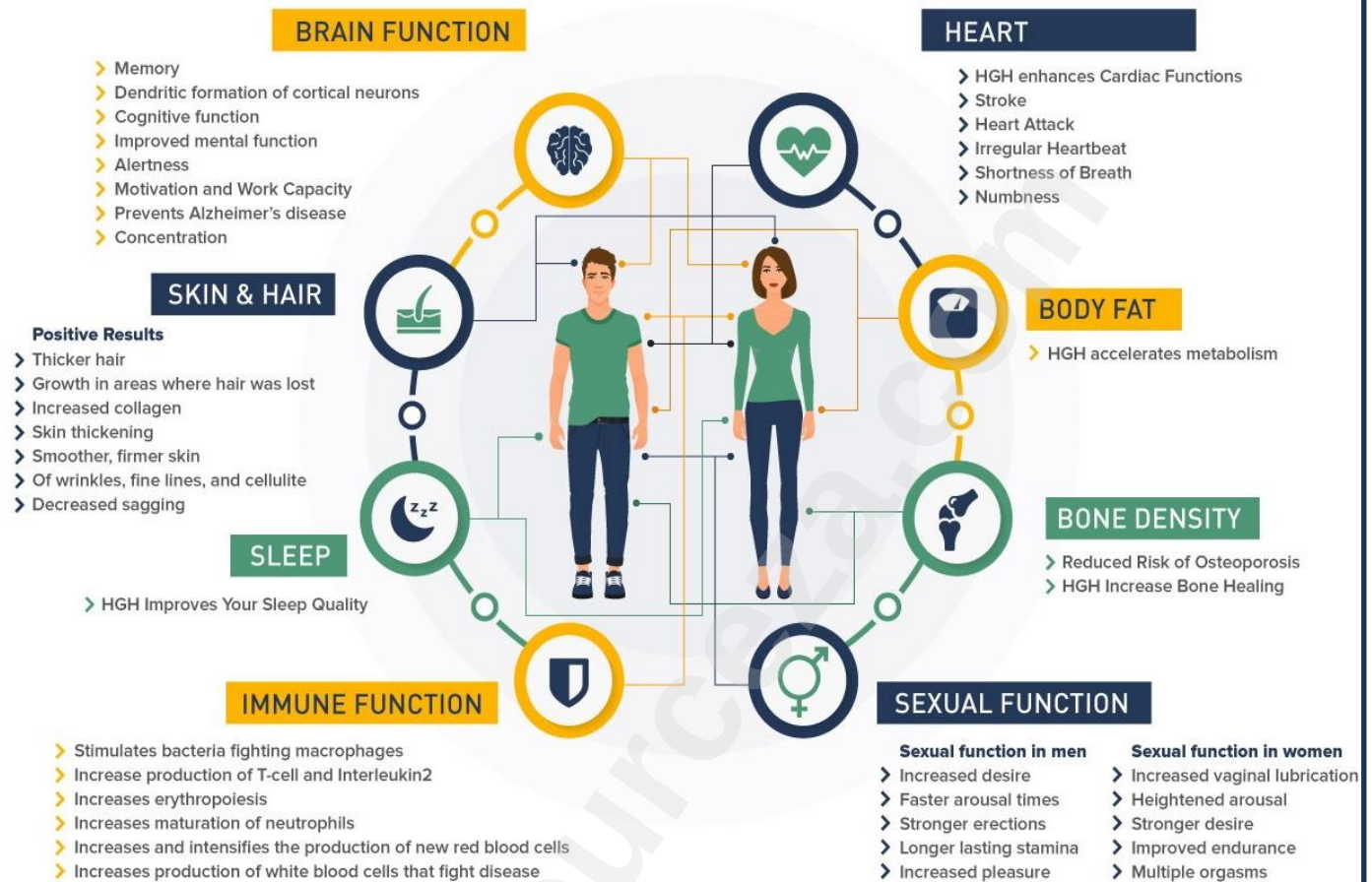


Normal



Acromegaly

HUMAN GROWTH HORMONE BENEFITS



[Source: <http://www.bidmc.org/yourhealth>]

Blood Sugar and Metabolic Syndrome

Metabolic syndrome is defined as a group of metabolic risks appearing together, including abdominal obesity, high cholesterol and triglycerides, high blood pressure and insulin resistance. It is caused by chronic hyperglycemia (high blood sugar) due to eating too many carbohydrates.

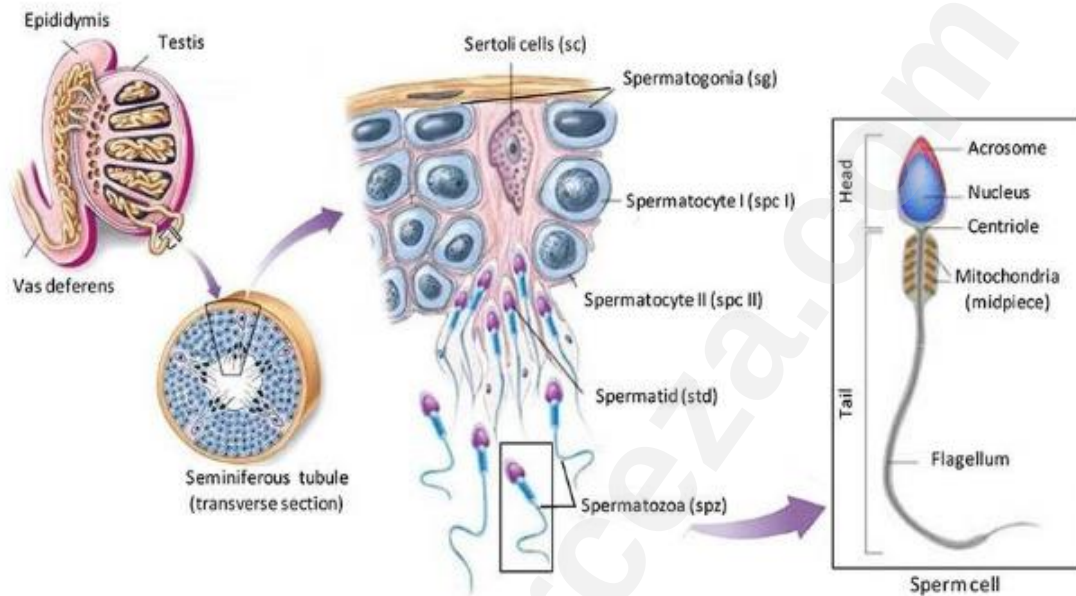
When you eat carbohydrates, the pancreas secretes insulin to move excess glucose from the blood into the cells, where glucose is used to produce energy. But over time, the cells lose the ability to respond to insulin. The pancreas responds by pumping out even more insulin to get glucose into the cells, and this eventually causes insulin resistance and hyperglycemia.

Insulin resistance can also cause low blood sugar. This condition, called reactive hypoglycemia, occurs when the body secretes excess insulin in response to carbohydrate meals – causing blood sugar levels to drop below normal.

Your body is genetically programmed to recognise low blood sugar as a threat to survival. Severe or prolonged hypoglycemia can cause seizures, coma, and death. When your blood sugar levels drop below normal, your adrenal glands respond by secreting a hormone called cortisol. Cortisol tells the liver to produce more glucose, bringing blood sugar levels back to

normal. The problem is that cortisol (along with adrenalin) is also a sympathetic nervous system hormone involved in the “flight or fight” response.

Structures involved in the sperm production in males



[Source: Researchgate.com]

Question 3**Source A****Treatment for infertility.**

Treatment for infertility can be through the use of hormone therapy, a change in lifestyle, or the option of adoption; In-vitro fertilization (IVF) and other treatments.

In-vitro fertilization is used for women who have no viable eggs, in which case donor eggs are used, or for couples who cannot conceive naturally. Eggs are removed from an ovary, and they are then fertilized outside the body with the partner's sperm. The fertilized eggs are placed in the woman's uterus and left to implant in the endometrium. This may not be successful, or some couples may end up with twins or triplets. This is a very expensive treatment, takes up a lot of the couple's time and is emotionally exhausting.

Sometimes fertilized eggs are implanted in a woman who is not the biological mother. They have volunteered to go through a pregnancy for another person and are known as surrogate mothers.

[Source: <http://capefertilityclinic.co.za/treatment>]

Source B: People's experiences**A gay couple**

The couple have found a surrogate mother to carry their child. The donor egg will be fertilized by sperm from one of the partners by in-vitro fertilization and then implanted in the surrogate mother who will give birth to their baby. The couple is very excited.

Helping a sister

Jackie's sister has had her uterus removed due to cancer. After in-vitro fertilization, several embryos were produced from her sister's eggs and husband's sperm. Jackie has offered to carry the baby (babies) for her. Jackie's husband is concerned about her decision but has agreed to support her.

Confused couple

Eli says that she and her husband cannot have children since both her oviducts are blocked. They cannot decide what to do next. Eli would like to adopt a baby whereas her husband wants to try in-vitro fertilization. Eli knows that it is very expensive and that there is only a 30% chance of success.

[Source: [www.blogspot.com/fertility Questions](http://www.blogspot.com/fertility%20Questions)]

Source C

The American government uses taxpayer money to support a private organization called Snowflakes, developed to encourage couples to “adopt” human embryos. While helping people have babies is ethically commendable, there is something very strange about extending the use of the term “adoption” to embryos. Children get adopted, but... embryos?

When couples seek treatment for infertility, they often use in-vitro fertilization or IVF. This is a procedure in which embryos are created outside of the body in a laboratory dish and are then implanted back into the woman’s body where, ideally, they grow to full term.

Often many embryos are created through this process. But since multiple pregnancies – quadruplets, quintuplets, septuplets and the like – produce premature and often unhealthy babies, doctors will only put two or three embryos back into the woman’s body to try and help her become pregnant. The clinic chooses to implant the embryos that look the healthiest and asks the couple if they want to freeze the rest. The couple also has the option of having the remaining embryos destroyed, donated to other couples, or donated to embryonic stem-cell research.

Snowflakes is run by the Nightlight Christian Adoption agency in Fullerton, California. The group has no medical background. They simply believe that every embryo is a baby from the minute it exists in a laboratory dish. They created a service that matches couples who have leftover embryos with other infertile couples trying to have babies. Most experts think there are as many as 400,000 embryos frozen in storage in the United States.

[Source: www.nbcnews.com]

Source D**Statistics**

Maximum age for IVF: 41 years

Approximate cost of IVF treatment: R60 000 to R120 000

Initial consultation: R1200 upwards

Initial blood tests: R1200 upwards

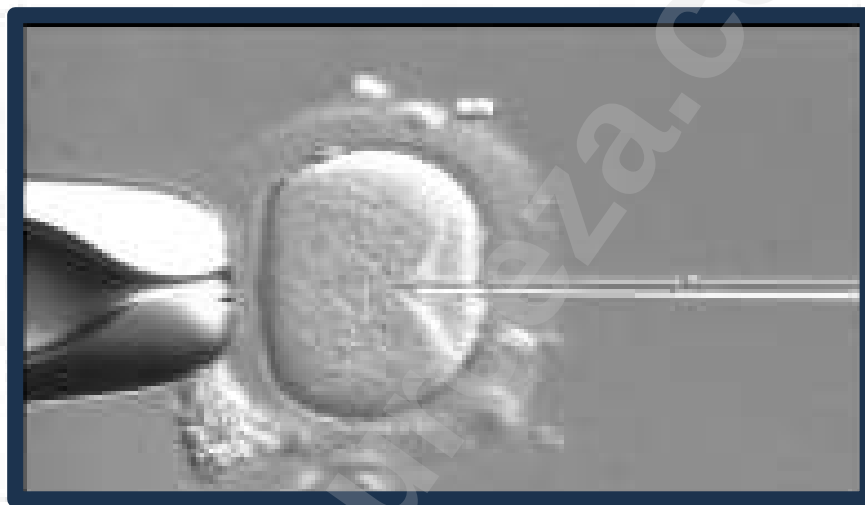
Success rate: 25% - 30%

[Source: Surrogacy the truth: <Health24.com>]

Source E**ICSI at the CAPE Fertility Clinic.**

Intra cytoplasmic sperm injection (ICSI) is a type of IVF. This is a procedure used in specific circumstances during IVF. The main reason to perform ICSI is because of a low sperm count or poor sperm morphology. Other reasons include sperm obtained by epididymal or testes aspiration or biopsy, previous failed fertilization in conventional IVF, when performing PGD (pre-implantation genetic diagnosis), to reduce transmission of HIV or to increase fertilization rates.

The embryologist will choose a single sperm cell (the best available) and inject it directly into the egg. This is done using a micromanipulation microscope. With ICSI nearly every man has the possibility to have his own biological child.



[Source: <http://capefertilityclinic.co.za/treatment>]

Source F

The Suleman octuplets are six male and two female children conceived via in vitro fertilization (IVF) and Nadya Suleman (nicknamed "Octomom") on January 26, 2009. They are only the second full set of octuplets to be born alive in the United States. The controversial circumstances of their high-order multiple births have led to a debate in the field of assisted reproductive technology as well as an investigation by the Medical Board of California of the fertility specialist involved regarding the transfer of twelve embryos at once.

Suleman's mother stated that a single sperm donor named David Solomon was used to produce the octuplets as well as her daughter's previous six children. The octuplets' grandfather and others have accused Suleman of making up a fictitious David Solomon.

In protests outside Suleman's house, people expressed concern that her decision for more children, despite being unemployed and unmarried, would burden taxpayers via public support.



[Source: Wikipidia,2015]

Source G

Because children are a great blessing and infertility is a cause of great heartache, reproductive technology appears to be at the service of human life and happiness. But while the use of technology to overcome fertility problems is not wrong in and of itself, many methods of reproductive technology, such as IVF, fail to properly reverence life, the unity of marriage and human procreation.

Reverence for life means that forms of reproductive technology which expend or harm human life by discarding, freezing or subjecting embryos to excessive risk are morally unacceptable. Reverence for the unity of marriage means that a couple should become a father or mother only together with the other spouse, thereby excluding forms of reproductive technology that involve donor eggs or sperm, or surrogacy.

The use of reproductive technology means that more children begin life with a single parent or a combination of 'genetic', 'gestational' or 'social' parents. This deprives them of the right to be conceived, carried in the womb, brought into the world and brought up within marriage.

Surrogacy involves a woman becoming pregnant, usually through assisted reproductive technology, and bearing a child for another woman or couple. Although the motives will often be good, surrogacy places the process of conception, birth and upbringing under a contract. In a surrogacy agreement, the child is the object of an arrangement aimed at fulfilling the needs of the 'parents'. In the absence of conclusive empirical evidence about the immediate and long-term effects of surrogacy upon children, surrogacy is an experiment in child welfare.

[Source: www.lifemarriagefamily.org.au]

Source H

Mitochondrial donation and 3-parent babies

Mitochondrial donation is an assisted reproductive technology sometimes described as “three-parent IVF”. It’s designed for women at high risk of passing on faulty mitochondrial DNA and having a child with severe mitochondrial disease. Mitochondrial diseases comprise at least 300 different genetic conditions which affect the energy-producing structures within human cells, impacting organ function.

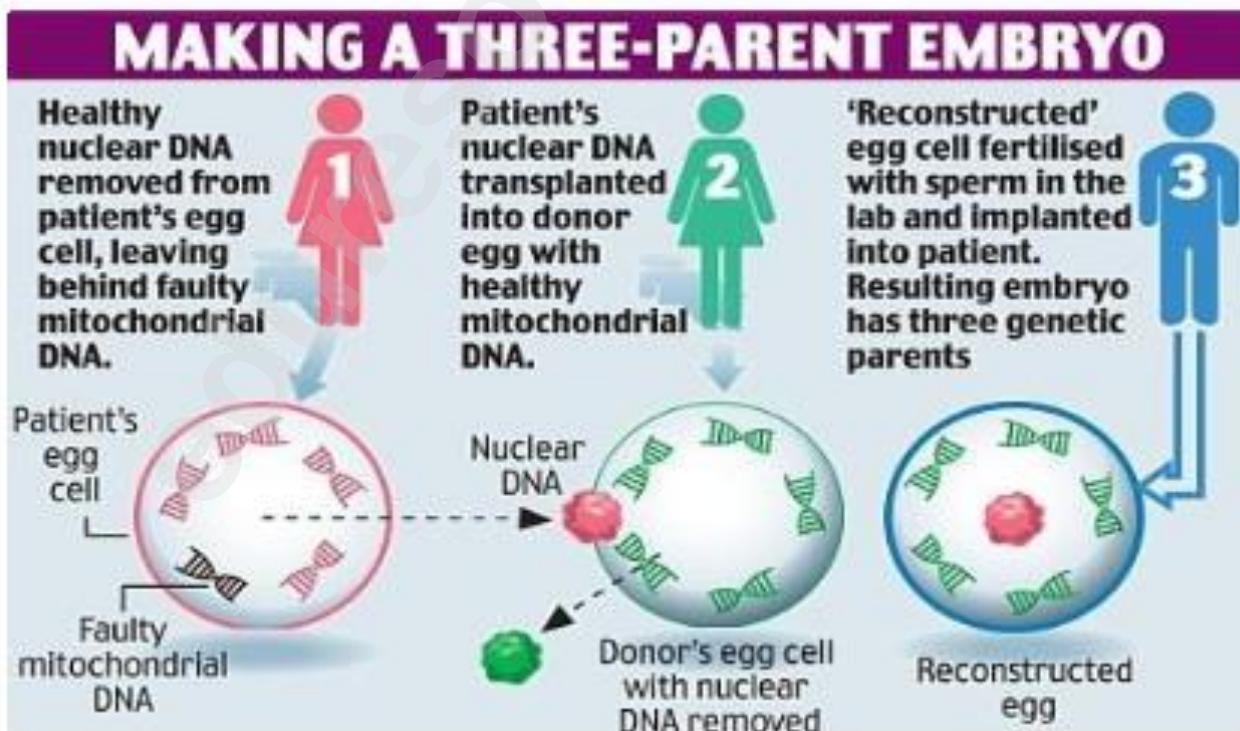
Mitochondrial donation involves combining the 20,000 or so unique nuclear genes from the mother with the same number from the father – but replacing the mother’s 37 unique mitochondrial DNA genes with mitochondria from a donor egg.

Mitochondrial donation was legalized in the UK in 2015. Now, Australia is considering introducing it. Couples would be able to access the procedure if the mother has a family history of mitochondrial DNA disease, which applies to 60 births in Australia each year.

At least one in 5,000 babies will be affected by a severe mitochondrial disease during their lifetime. Problems in mitochondrial energy generation can present at any age and affect any organ system. We don’t have effective therapies so, tragically, most affected children die before age five from respiratory failure, heart failure, liver failure or other causes.

While couples with a family history of conditions like muscular dystrophy or cystic fibrosis can use IVF technologies to have a child who will not be affected, these options are generally unreliable for the prevention of mitochondrial DNA disease.

This procedure would offer Australian couples with a family history of mitochondrial DNA disease access to reproductive technology to facilitate the conception of a healthy child genetically related to both parents.



[Source: <https://theconversation.com>]