

Are we heading to
reproductive extinction?

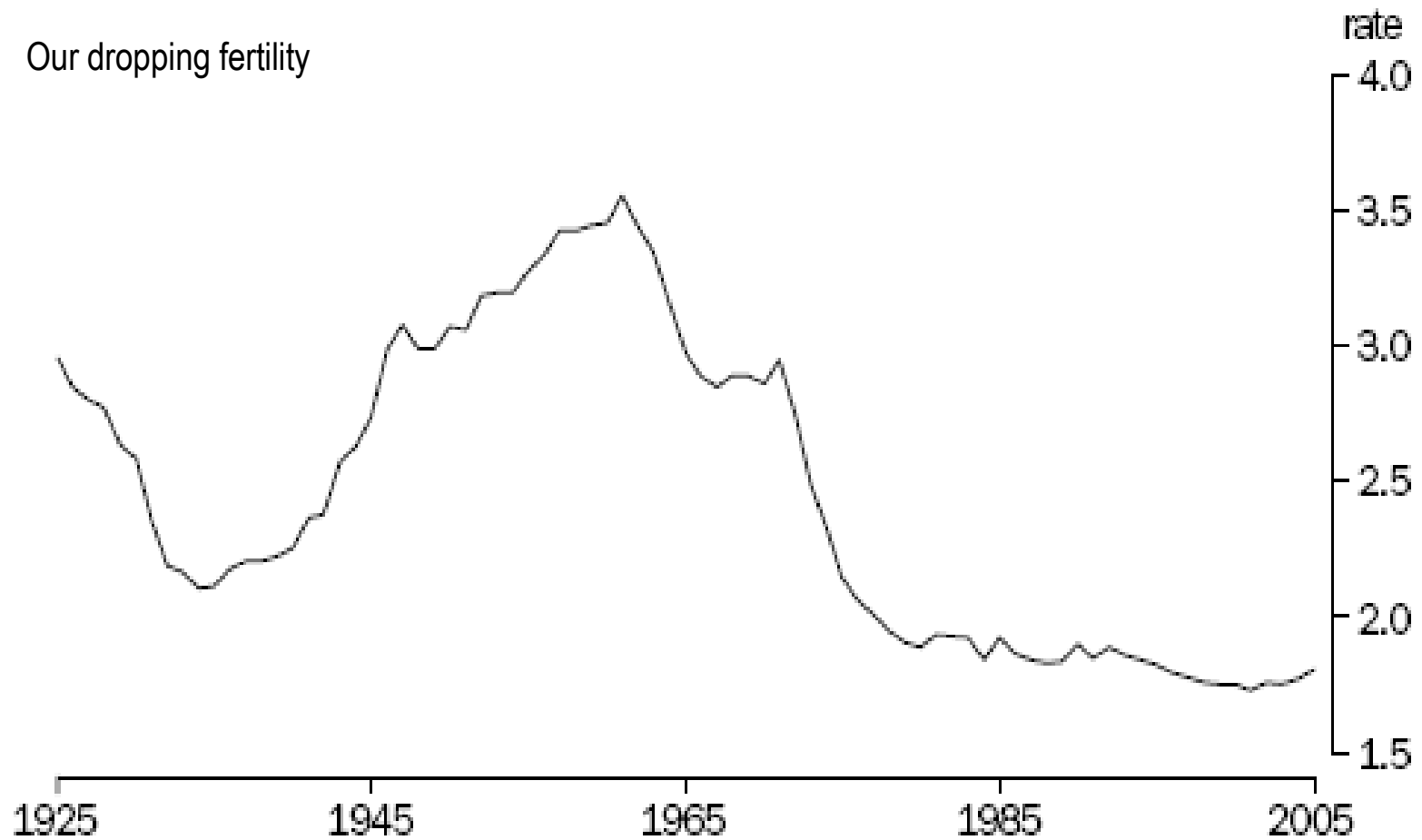


THE UNIVERSITY
OF ADELAIDE
AUSTRALIA

Robert Norman

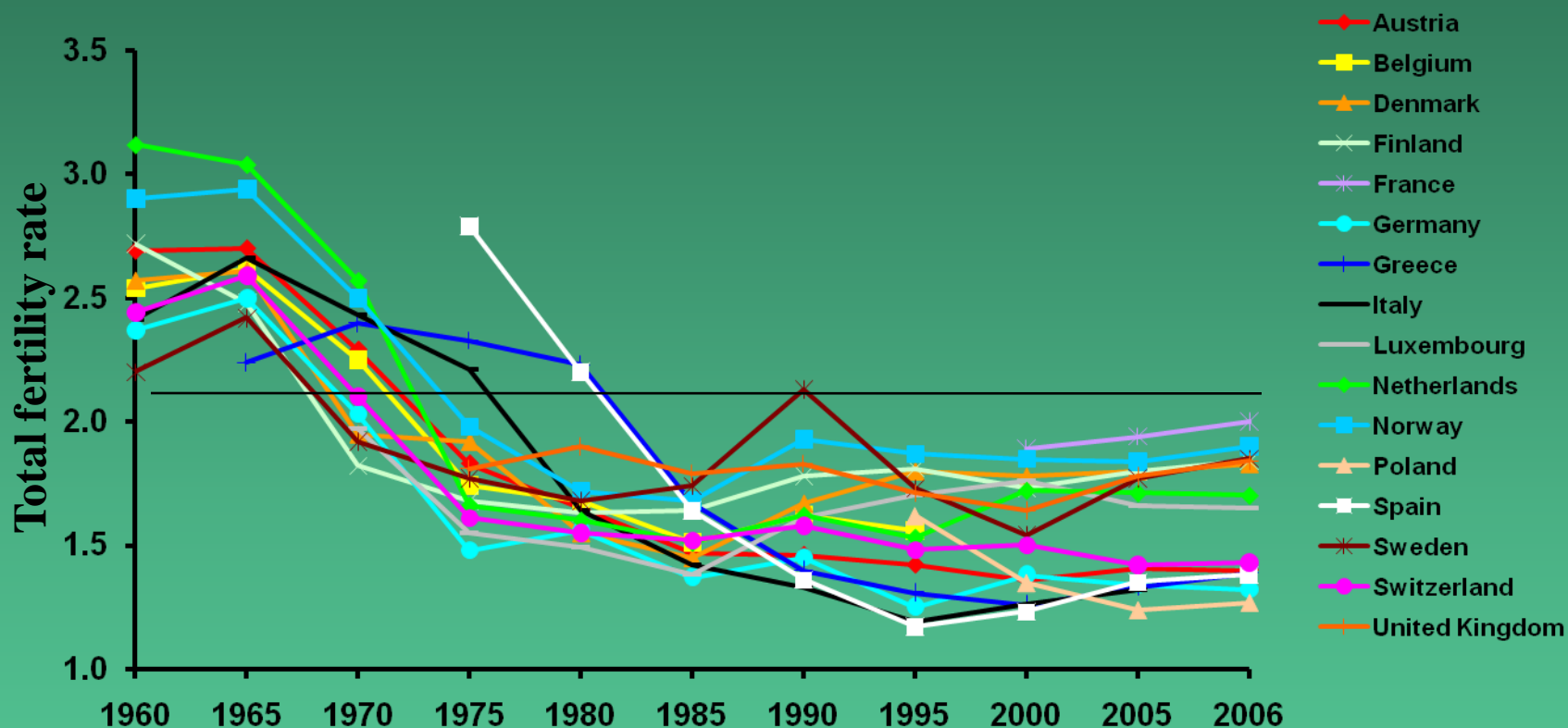
The Robinson Institute
University of Adelaide

Australia's fertility



(a) Births per woman.

Total Fertility Rate in Europe 1960-2006



In more developed countries, a rate of 2.1 is considered to be the replacement level; in 2006, Germany, for example, had 1.32 children per couple

Total fertility rate = mean number of children that are born alive to a woman during her lifetime.

Eurostat. http://www.euphix.org/object_document/o5405n28150.html. 2008.

Parts of Asia are not much better

1.	Hong Kong	0.94
2.	Macau	1.00
3.	Ukraine	1.16
4.	Lithuania	1.19
5.	Czech Republic	1.20
6.	China	1.20
7.	Bosnia and Herzegovina	1.21
8.	South Korea	1.22
9.	Poland	1.24
10.	Singapore	1.24

11.	Slovenia	1.24
12.	Latvia	1.26
13.	Russia	1.27
14.	Spain	1.28
15.	Italy	1.28
16.	Andorra	1.29
17.	Japan	1.30
18.	Armenia	1.32
19.	Hungary	1.32
20.	Slovakia	1.32

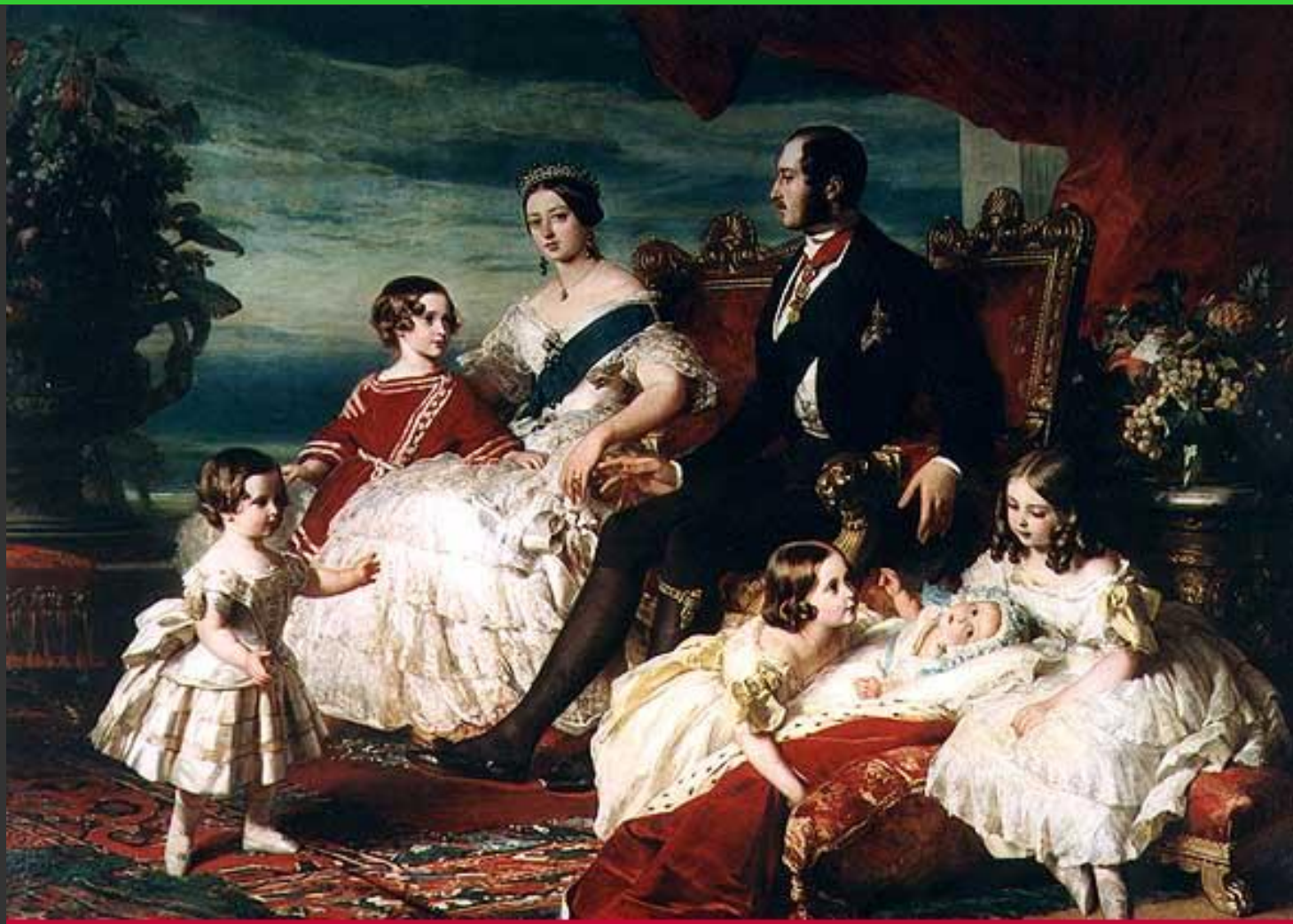
Source :

*CIA FACTBOOK
2005 Estimates*

Failure to reproduce – causes

- **Voluntary due to circumstances, choices and society**
- **Medical due to genetics, illness, biological, natural selection**
- **Environmental due to known and unknown causes**

Queen Victoria and her family





Edward, Duke of Kent
(1767-1820)

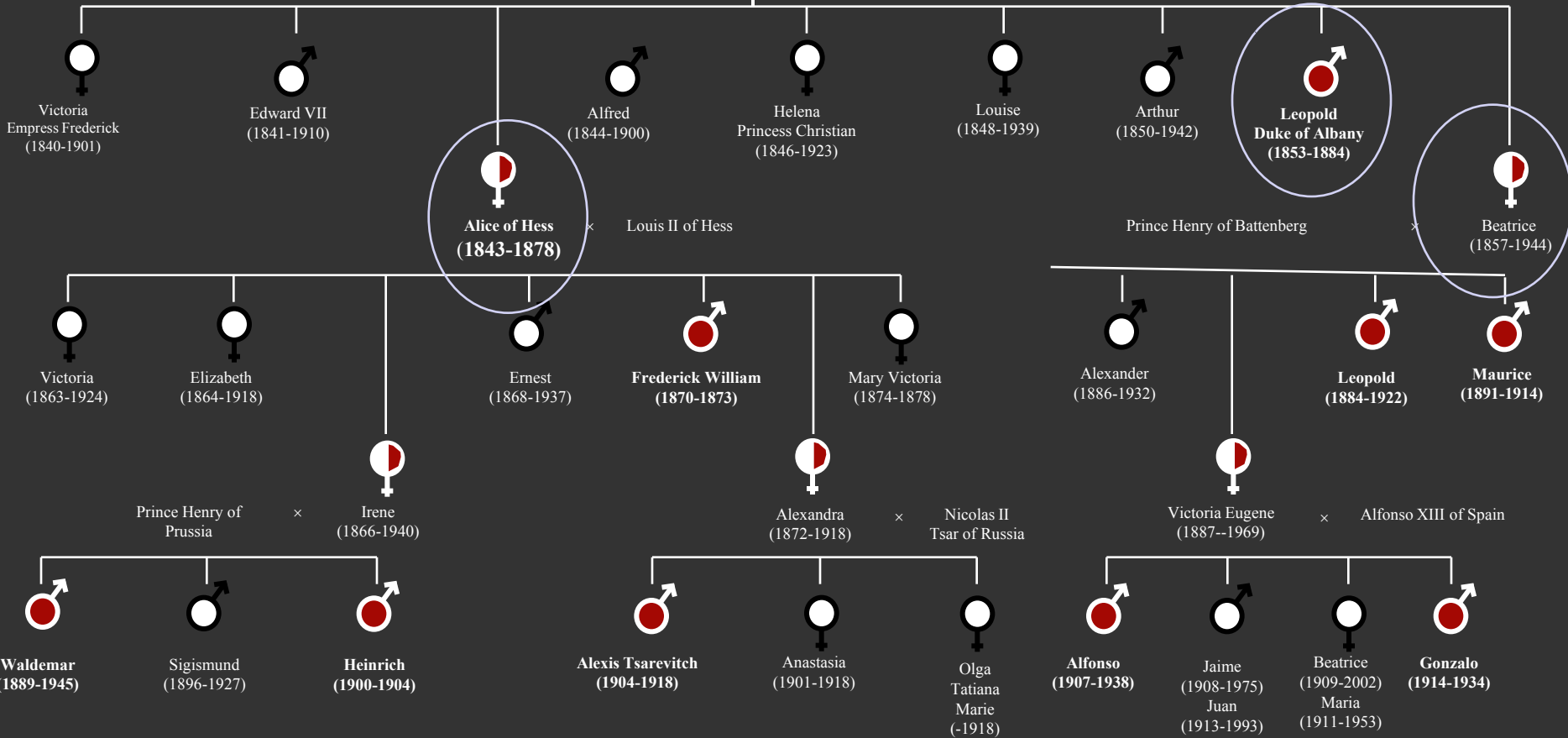
Princess Victoria of Saxe-Coburg
(1786-1861)

×

Queen Victoria
(1819-1901)

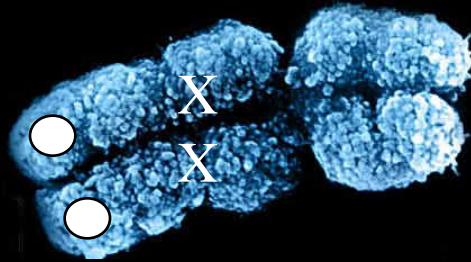
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Prince Albert of Saxe-Coburg-Gotha
(1819-1861)



Infertility due to early death

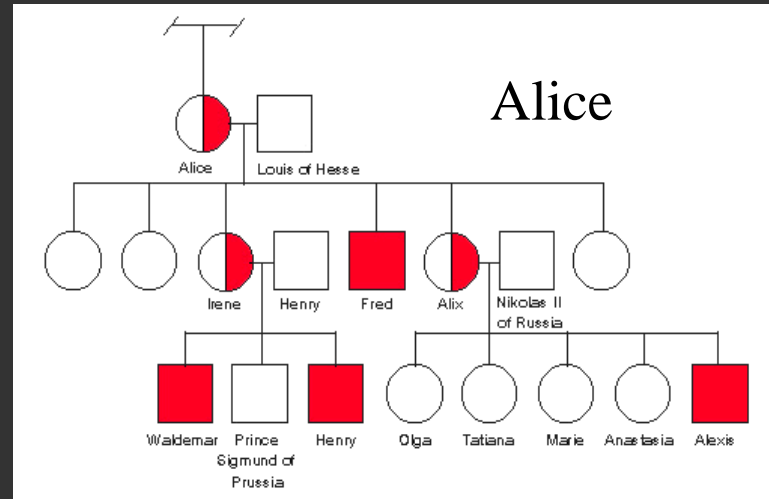
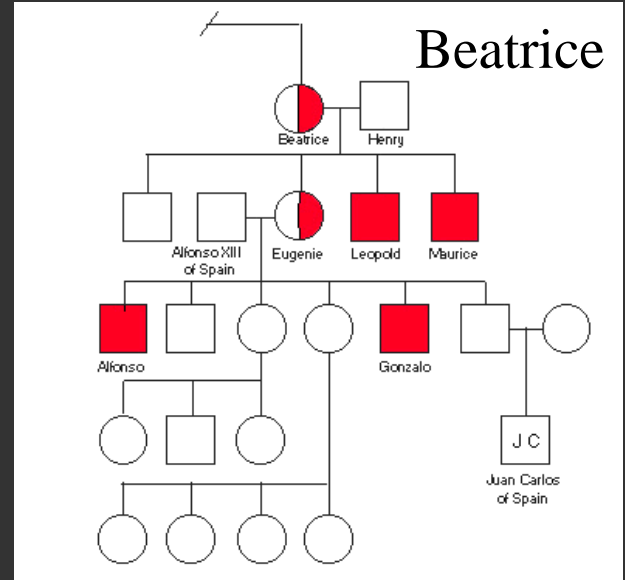
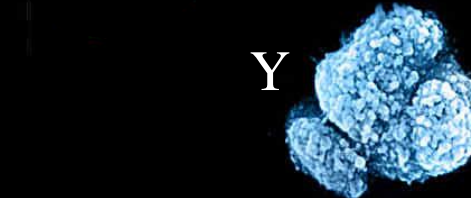
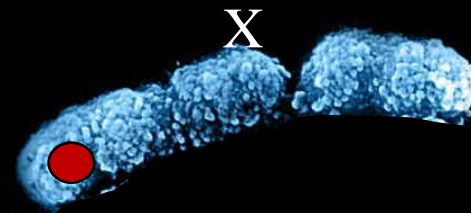
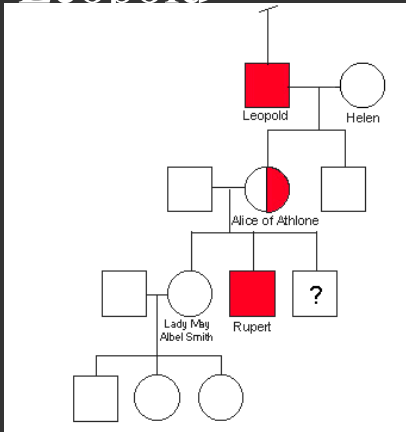
Normal factor VIII gene



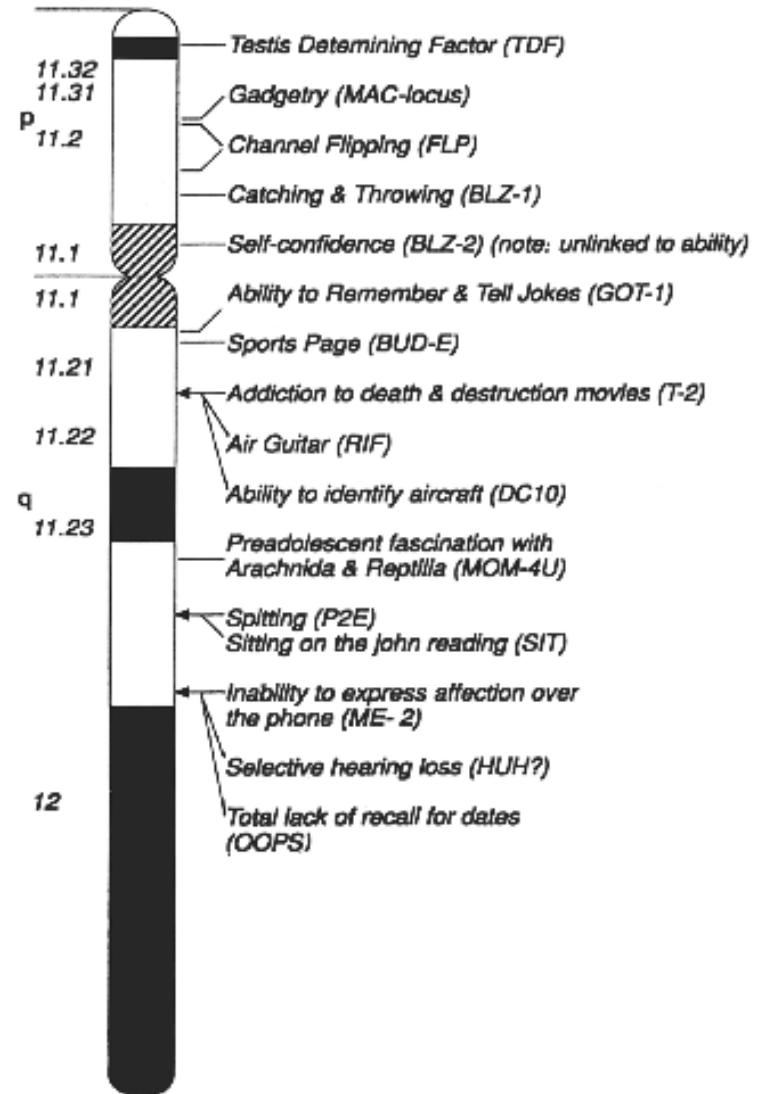
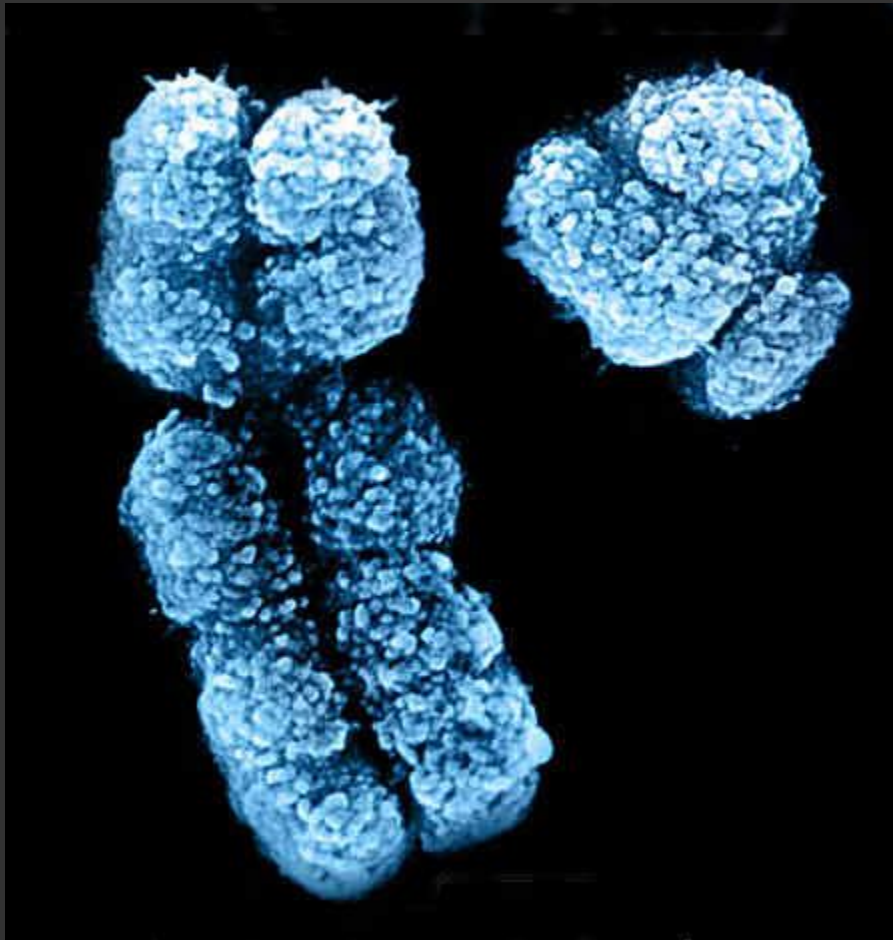
Haemophilia carrier



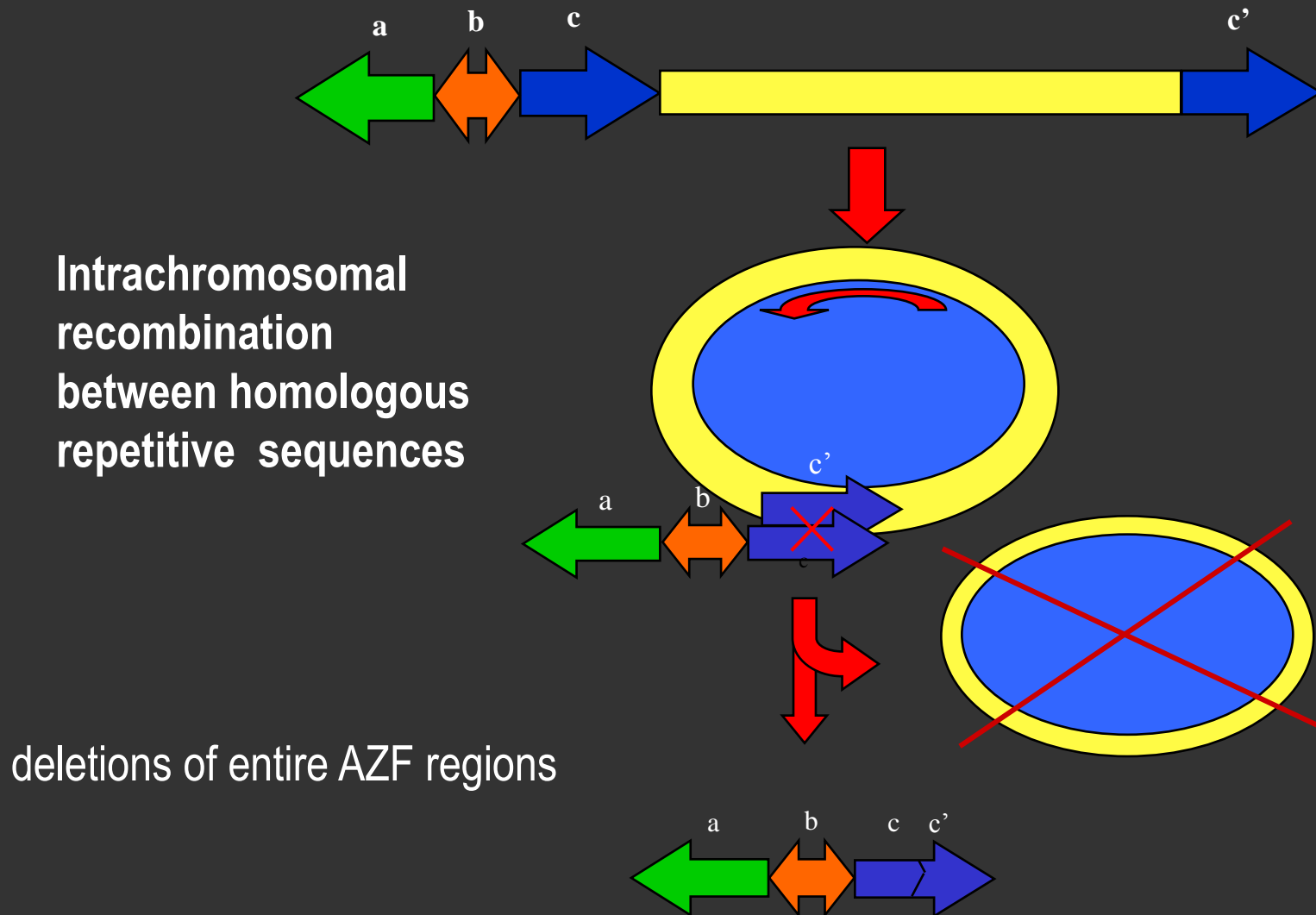
Leopold



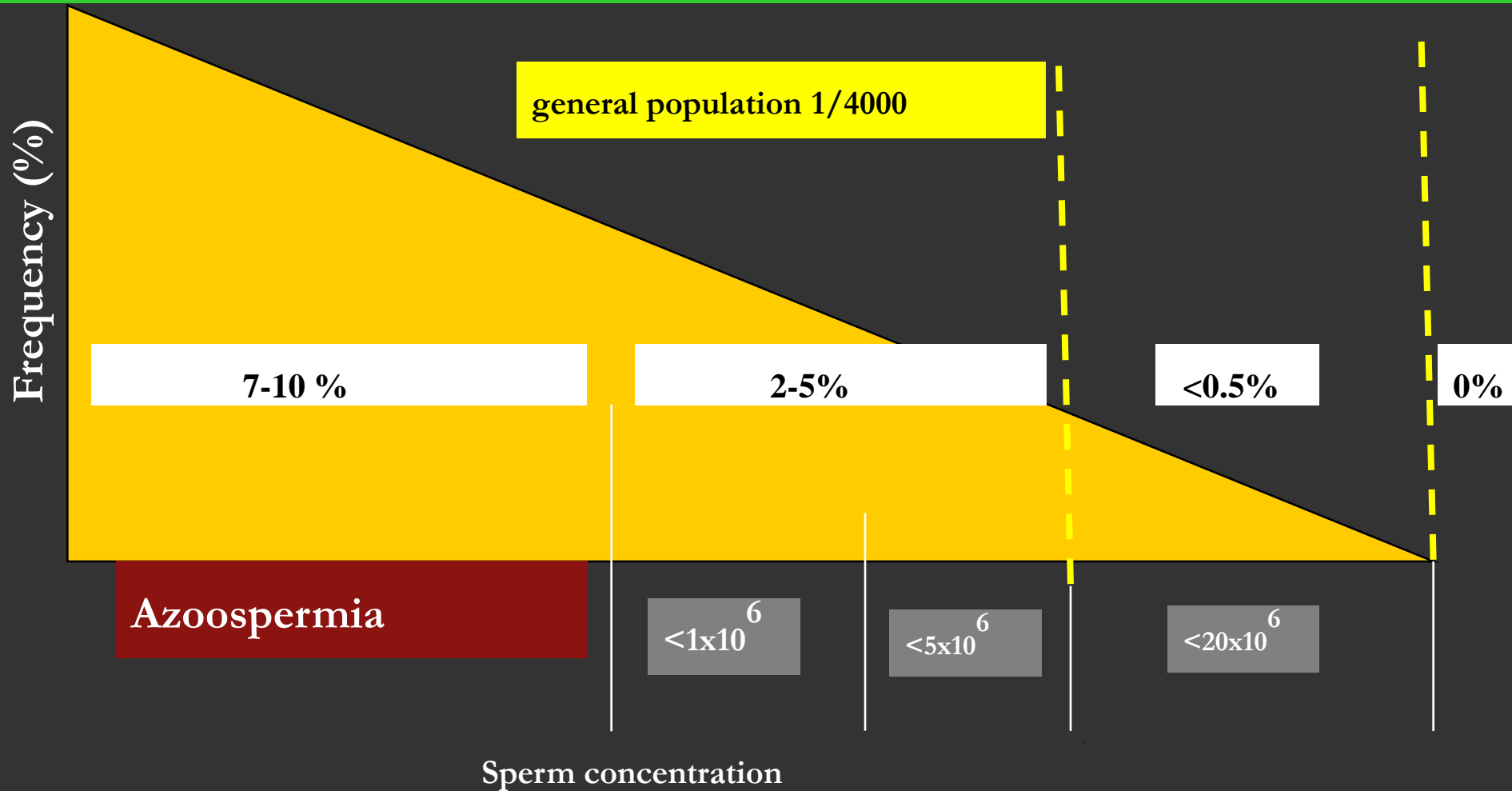
The disappearing Y chromosome



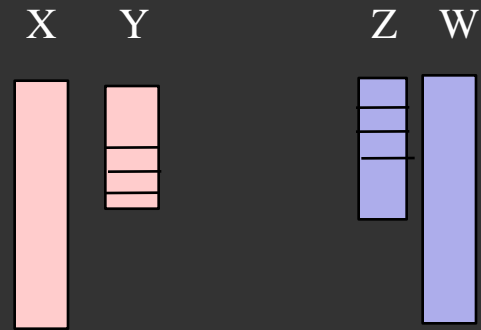
Y chromosome vulnerable to change



Y chromosome microdeletions



Environment affects reproduction



Humans

Vipers/Birds



Male



Female

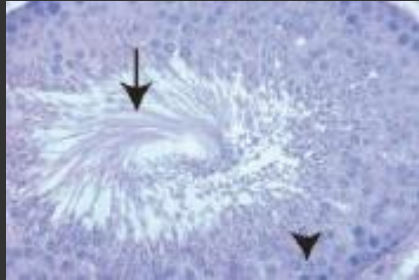


Temperature

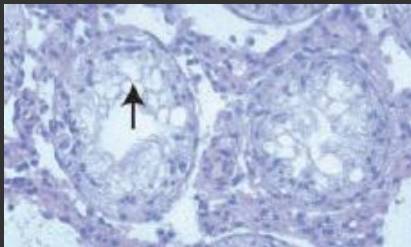
Transgenerational defects



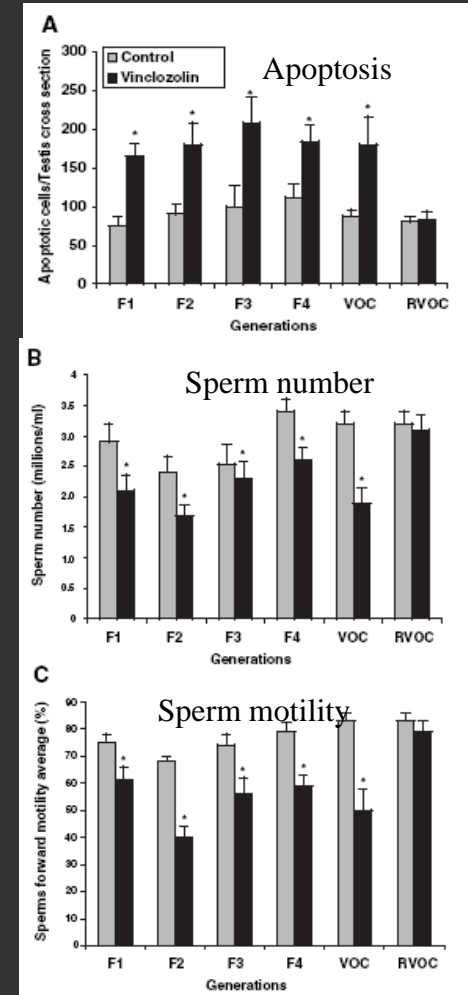
Control



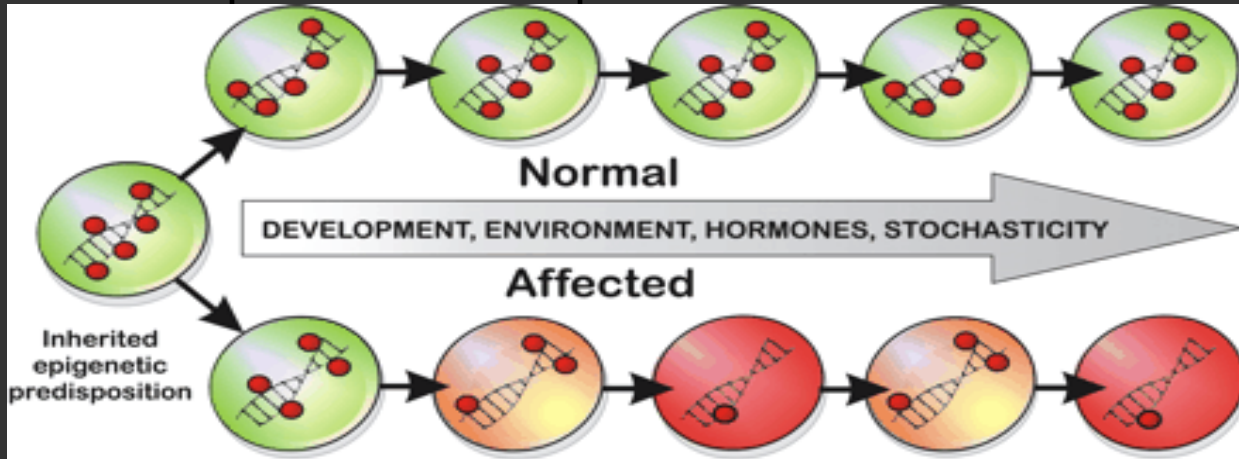
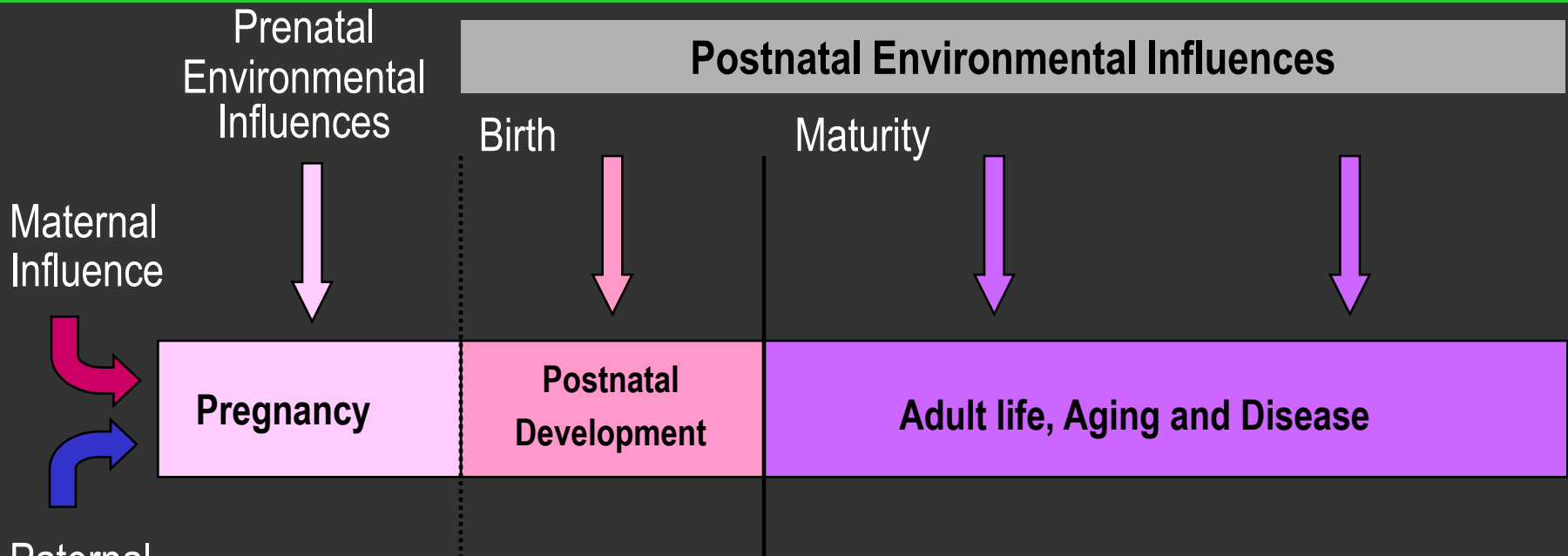
Vinclozolin



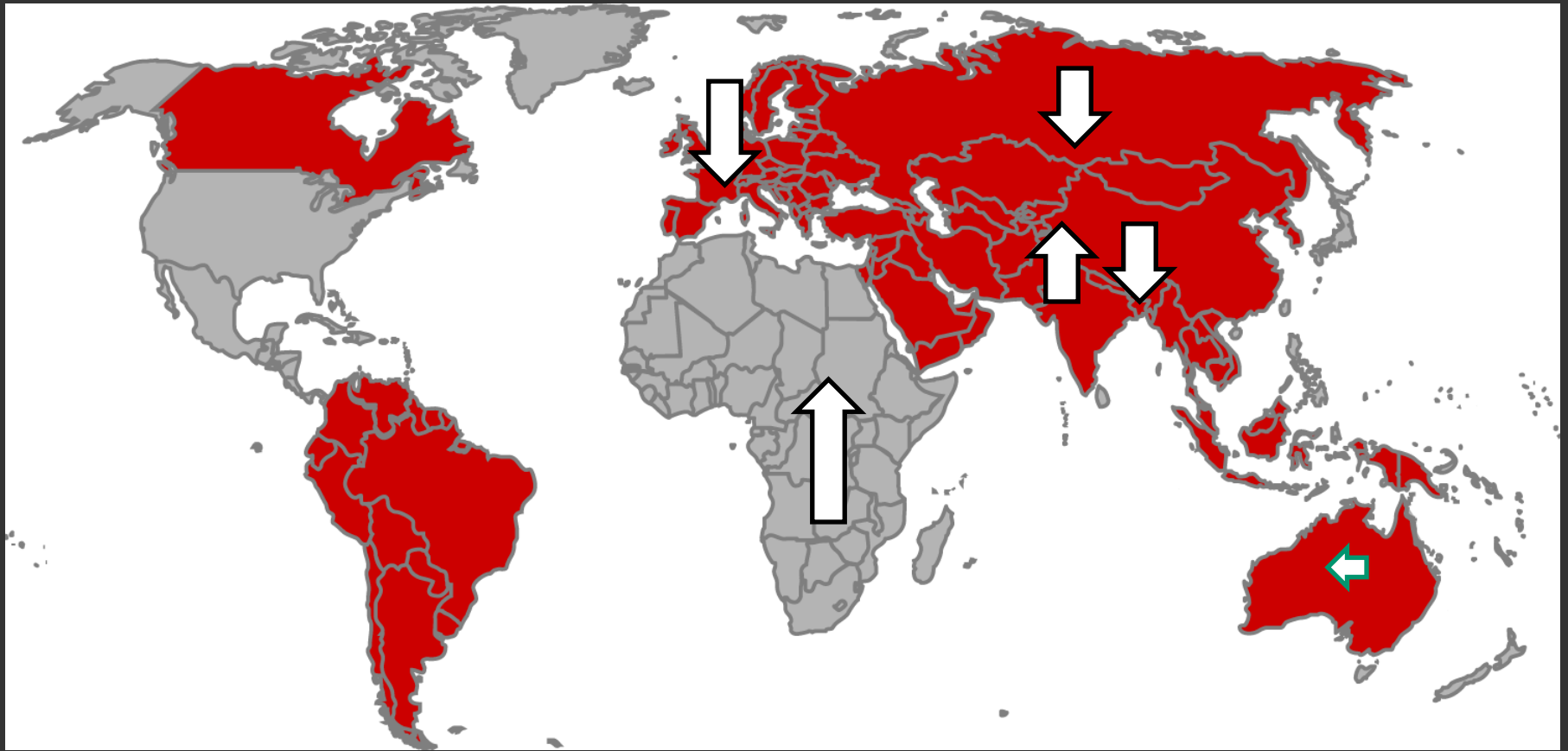
- Vinclozolin, a fungicide used in the wine industry, causes reproductive abnormalities in male rats when applied in pregnancy (binds to androgen receptor)
- Can be detected in nearly all male offspring for at least 4 generations
- Not seen in female siblings



Environment can change gene expression



Changing demographics in regions



Economics, politics and reproduction

- **Education**

- Length of time in training
- Cost of education (especially in USA)
- Economic disadvantage

- **Housing**

- Cost of housing
- Effect of peer envy

- **Work**

- Need for two salaries
- Long hours, far distance, different patterns
- Lack of child-care, changes in grandparents



Environment and lifestyle

Lifestyle issues

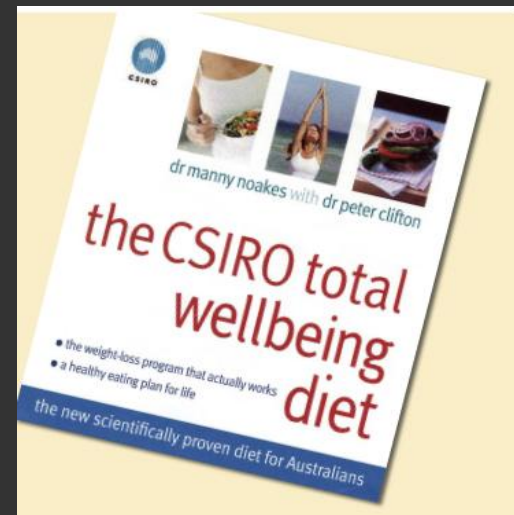
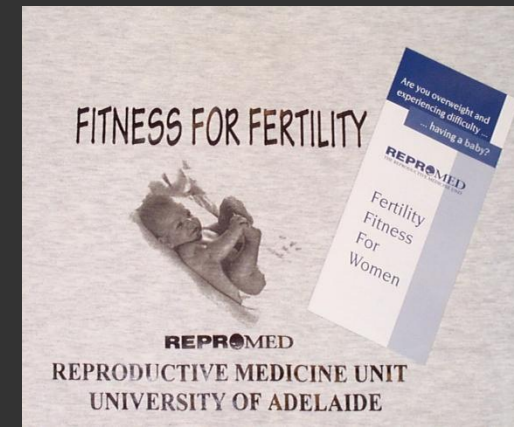
- Weight and obesity
- Smoking
- Delayed age of fertility
- Recreational drugs
- Nutrition and diet
- Exercise

Environmental factors

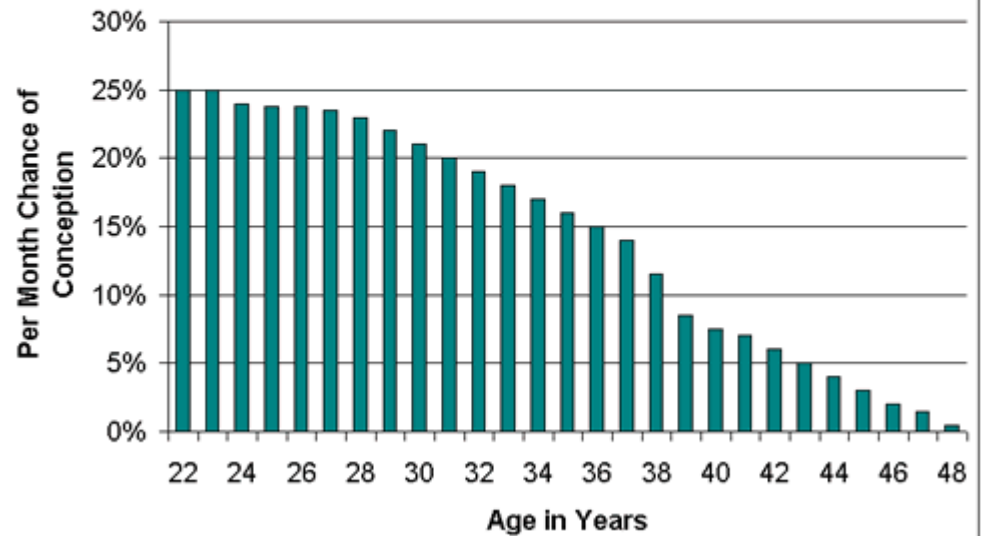
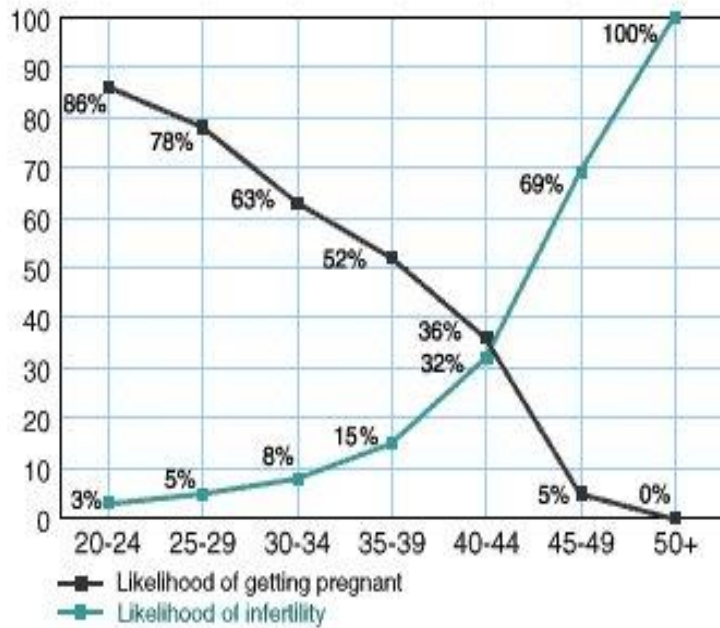
- Falling sperm counts
- Environmental toxins

Unknown causes

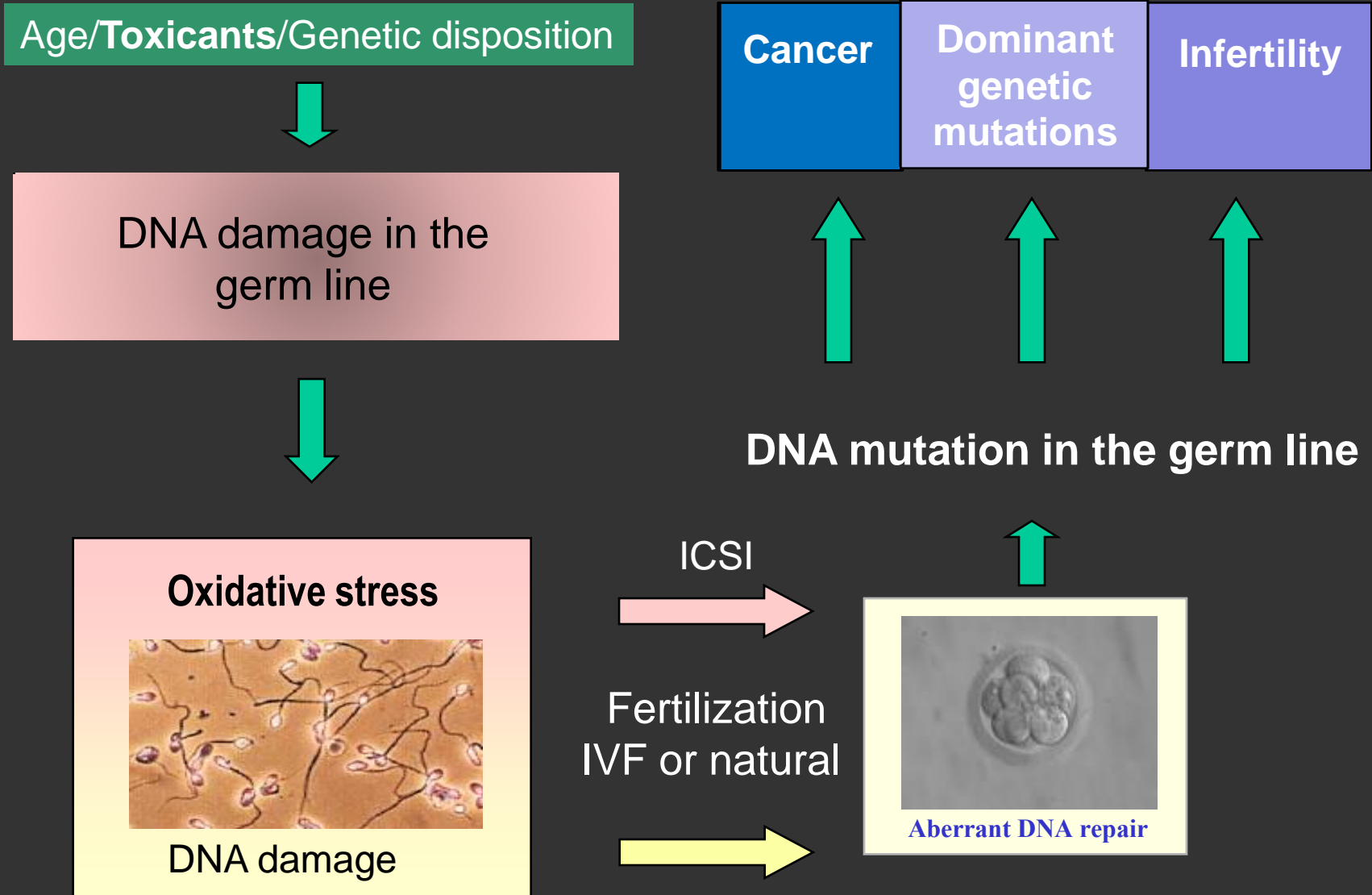
- Understanding reproduction



Age and fertility



DNA damage: affecting our sperm quality



How do we respond as a society?

- No worries
 - welcome drop in population
- Immigration
 - benefits and problems, reproduction differences
- Economic stimulus
 - baby bonus, reduced taxes
- Social welfare
 - subsidised child care, maternity leave, friendly work place
- Societal change in attitude
 - All factors including male
- Assisted reproductive technology

Male fertility can be by-passed



THE AGE
140th Year, No. 43,312

Miracle of Joshua heralds a breakthrough

Sue-Ellem Sipek with six-week-old Joshua, after three failures using the older IVF techniques, she had not been counting on success.

By RICHARD MACEY
Joshua Sipek is far too young to know that his entry into the world last month marked a milestone in Australian medical science. His birth, in Adelaide on 12 February, means almost any man may be able to father a child, even if he can produce only one healthy sperm.

Normally a man produces between 50 million and 80 million sperm for every millilitre of semen. But if the sperm count falls to about five million per millilitre, infertility can be a problem.

IVF techniques have had limited success helping couples in this situation.

AUSTRALIA'S IVF MILESTONES

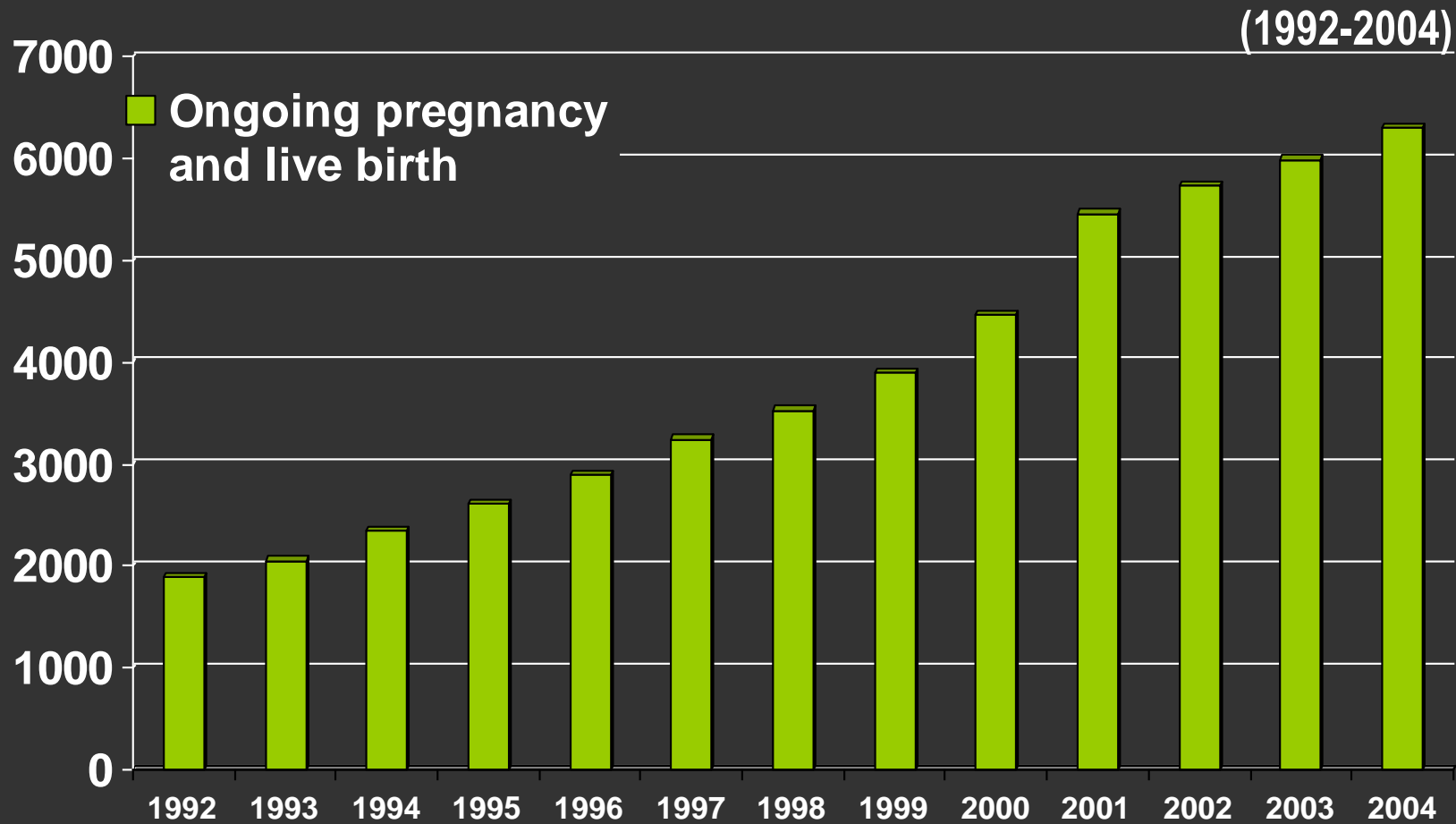
- November 1983: First baby born using donor egg technique developed by doctors in the Queen Victoria Medical Centre-Monash University-Epswom Hospital team.
- January 1984: World's first test-tube quadruplets born in Royal Women's Hospital.
- March 1988: Melbourne woman gives birth at Queen Victoria Hospital to baby girl born frozen embryo.
- June 1991: Monash University's Centre for Early Human Development develops technique to treat sperm infertility. Sperm quality within micro-injected through outer shell of an egg, allowing sperm direct access to fertilization.
- December 1992: First baby in the world born as a result of micro-injection intra-cytoplasmic transfer technique, used by the Monash University IVF team. Sperm injected into egg, then transferred into fallopian tube.
- September 1993: Melbourne researchers achieve the world's first pregnancy by taking unripe eggs from ovaries and artificially maturing them outside the body in two days.

Failed. The couple then turned to the Adelaide team for help. get fertilised, some don't and some get over-fertilised with more than one

The Lone Sperm
Hi-Lo Syringe
K. J. Jones

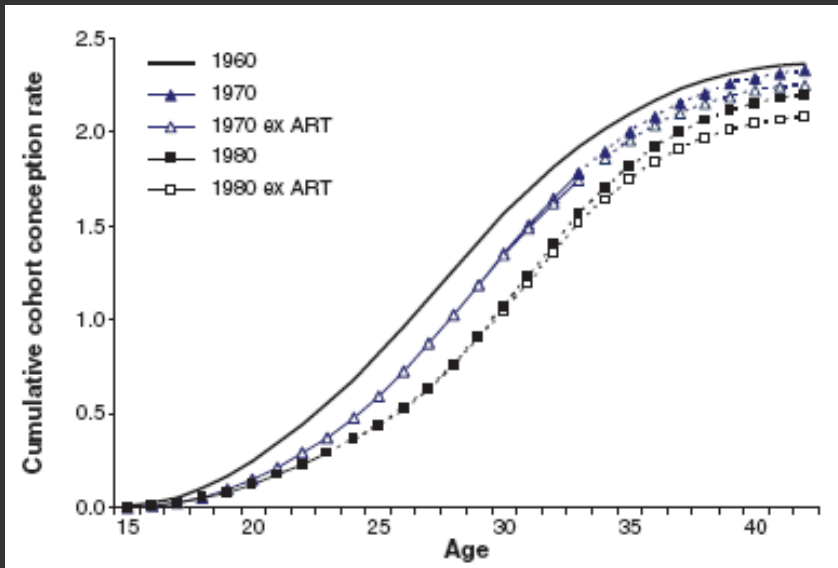
Australia's first ICSI pregnancy (Adelaide) - third group in the world

IVF pregnancies in Australia & New-Zealand: ongoing numbers

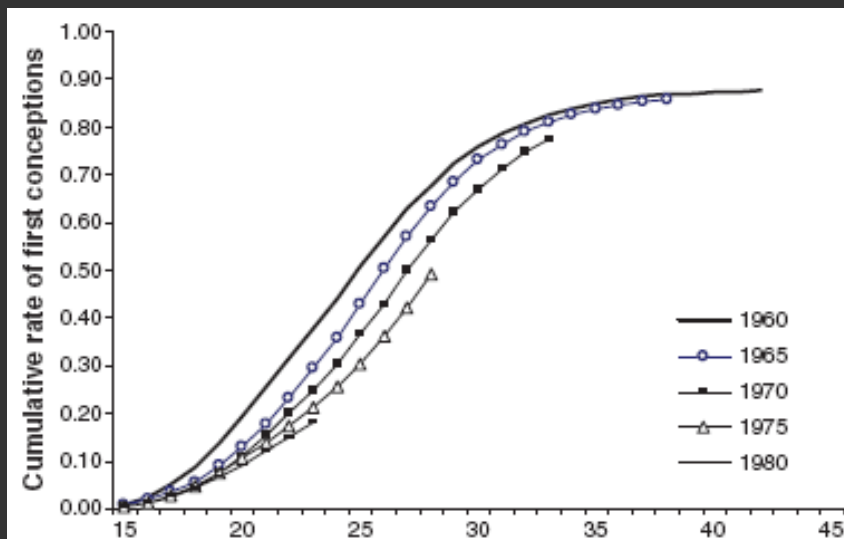


Cost including drugs around \$7000 per cycle – >\$250 million per annum

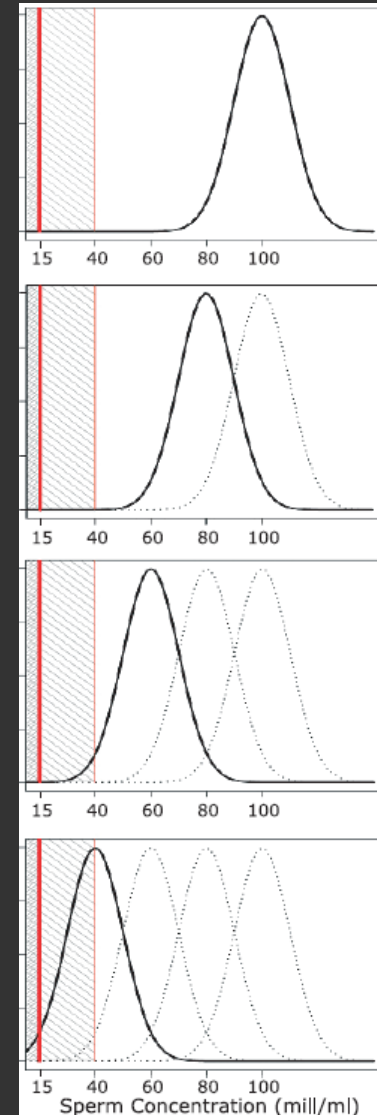
Cohort conception rates in Denmark with and without ART



Proportion of first conceptions in Denmark without ART



Simulation of effects of decreasing sperm counts on fertility



100 million/ml
"Old days"

80 million/ml

60 million/ml

40 million/ml
"Current time"

What is on the reproductive menu in 2009

- Contraception – male or female
- Termination of pregnancy
- IVF in/outside reproductive life
- Storage of sperm and eggs
- Donor sperm, eggs, embryos
- Sex selection of embryos
- Genetic diagnosis of embryos
- Personalised stem cells
- Surrogacy and sexless reproduction
- Sexual rejuvenation with lifestyle drugs



Affluence and reproductive extinction

- Small families means selection against fertility
- Environmental infertility factors increasing
- Use of IVF promotes ongoing use of IVF
- Reproductive technology will be self-perpetuating
- Need to provide more information to society
- Need to provide pro-fertility policies
- World political dynamics will affect fertility policies
- Investment in children and early development