

10. Sex versus Reproduction



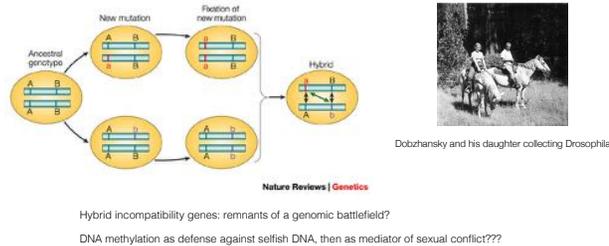
Nymph And Satyr
Portrait of a Satyr and lovely Nymph by the French artist Charles Antoine Coypel (1661-1727) - Musée des Beaux-Arts d'Angers (France)

Pascal Gagneux

February 6, 2020

Nymphs and satyres were mythical creatures in ancient Greece known for their strong sexual drives

Genomic Parasites (selfish DNA) and the origin of species



Dobzhansky and Mueller proposed a genetic model for species formation called the Dobzhansky-Muller incompatibility model. As populations get separated, different populations accumulate independent genetic changes (mutations). Such mutations can cause incompatibilities when they are inherited by an offspring when populations come together again. Genomes evolve genomic protection mechanisms that shut down selfish DNA from copying itself. This leads to an evolutionary arms race between selfish DNA and genetic defense mechanisms. These rapidly co-evolving systems also give rise to incompatibilities when hybrid offspring inherit one type of selfish DNA and the enacted genomic defense mechanism.

Practice question: How could transposable elements contribute to the formation of new species? Different populations can evolve different transposable elements and different genomic defenses against their spread. When these populations come together again after long isolation, there can be a mismatches between the transposable elements and the respective genomic defenses, causing damage to the hybrid offspring.

Sex on and in our minds



Sigmund Freud

Hugely influential thinker who articulated the central importance of sex and libido in human affairs.

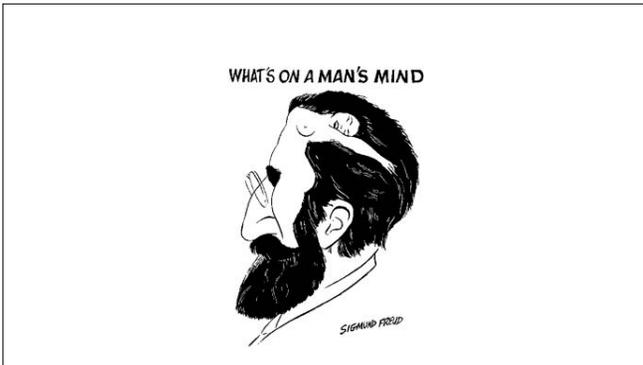
Many of his theories have never been empirically proven and some his most famous ones are almost certainly false: oedipus complex, penis envy, immaturity of female clitoral orgasm.....

Capgras (Imposter) syndrome: conviction that a close person is an imposter.

Freud got a very important fact widely known: sex is at the center of many human sentiments and motivations...

But he also got countless things wrong, and did not believe in testing theories experimentally.

a heterosexual male's view of Freud



Morin, Keefe, and Naftolin on "good for the species"



Scott Morin David Keefe

Frederick Naftolin, MD
Research Professor, Department of Obstetrics and Gynecology
Clinical Professor, Department of Environmental Health

"traits that foster the survival the species" Old fallacy of conceiving as "the species" being a unit of selection.

Agrarian societies, less sophisticated societies, lower life forms.....etc

The authors of the reading, all three medical doctors. They make many very pertinent observations. They also continue the disproven theories of "for the good of the species". Natural selection works most strongly on individuals and the genetic variants these contain. In addition they write about "unsophisticated populations migrating out of agrarian areas"

Practice question: What is wrong about the notion of survival of the species?
Natural selection mostly acts on individuals and not on species as a whole.

Eusocial mammals?



Heterocephalus glaber, naked mole rats
reproductive dominance of single mother



Fukomys damarensis, Damaraland mole rats,
the only other eusocial mammal.

Mole rats, naked and Damaraland, are the only eusocial mammals with a single reproductive female for a whole social group. Marmosets and Tamarins can also exhibit reproductive suppression of females by a breeding dominant females, but their groups are smaller family groups.

Practice Question: Are there eusocial mammals?
Yes, naked mole rats.

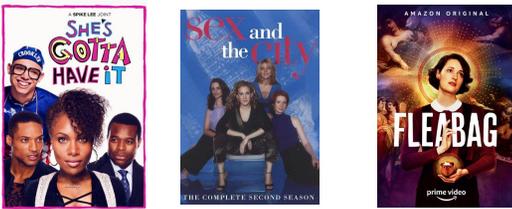
Vera Gorbunova and Andrei Seluanov U.of Rochester

Longevity research with naked mole rats



Vera Gorbunova and Andrei Seluanov U.of Rochester

The message from New York and London

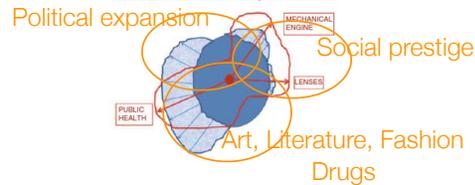


intelligent, well-respected women choosing their sexual lives

In the last few decades, popular media, such as full feature movies and TV series are beginning to portray women with assertive sex lives, without morally judging them as dangerous or bad.

Sex and social evolution

SOCIAL EVOLUTION AS THE DRIVER OF NATURAL SELECTION
Although Natural Selection (dark blue area/perimeter) has greater inertial mass, it is driven to fit ecological niches (light blue area) exposed by Social Evolution (examples - red perimeter and arrows). As evolved forms flow into those niches the context of evolution changes. In this manner, Social Evolution has become the zeitgeber of human evolution.



Morin et al. in L. Zhang and C.A. Ducusay (eds.), Advances in Fetal and Neonatal Physiology

Social evolution, really a part of cultural evolution is now greatly impacting reproductive success of individuals in modern populations.

Practice question: Give a few examples of cultural constructs that could strongly affect reproductive success.

Social prestige, political power, stardom as actor, designer etc.

Sex and social evolution

200,000 years of modern *Homo sapiens*

10,000 years of agriculture
5,000 years of writing
200 years of industrial revolution

plenty of social evolution long before the industrial age!

tribalism, marriage rules, honor killing etc

Are humans still evolving?

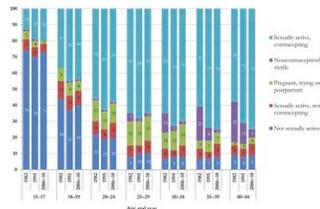


Social and cultural evolution have become very powerful, but natural selection is ongoing!

Framingham Study in New England: three generations of women showing clear evidence for heritable changes in sexual maturation, age at menopause, cardiovascular parameters!

Any living population IS evolving (how precisely, is a much more difficult question!)

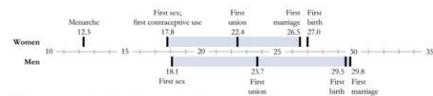
Female sexual activity



Finer LB and Philbin JM. Trends in Ages at Key Reproductive Transitions in the United States, 1961–2010. *Women's Health Issues* 2014.

Female sexual activity starts in the mid-teenage years for many young women in the US. The large majority of the reproductive years are spent sexually active. Thus, women have a lengthy period during which they require effective methods. In particular, the period between first sex and first childbearing has lengthened, but long-acting method use, although increasing, has not kept up with this shift. Moving the contraceptive method mix toward underutilized but highly effective contraceptive methods has the potential to reduce the unintended pregnancy rate.

Female and male sexual activity



Shaded area represents period of high risk for nonmaternal birth.
Both cohort for each estimate.

Women: Menarche 1995, first sex and first contraceptive use 1995, first union 1998, first marriage and first birth 1992.

Men: First sex 1995, first union 1996, first marriage 1995, first birth 1998.

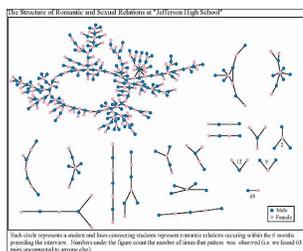
Figure 3. "Current" median ages at reproductive events (i.e., median age at event for most recent cohort for whom data are available).

Finer LB and Philbin JM. Trends in Ages at Key Reproductive Transitions in the United States, 1961-2010. *Women's Health Issues* 2014.

On average, young women start engaging in sexual activity a little sooner than teenage boys.

Menarche has shifted towards younger age than used to be even 100 years ago.

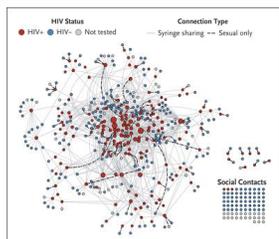
Visualizing sexual networks



Beaman et al. *Am J Sociol*, 2004

sexual networks at a high school in mid-western America. Anything from unconnected pairs to slight connections to hyperconnected individuals, both male and female.

Visualizing sexual and infectious networks



Philip J. Peters et al. HIV Infection Linked to Injection Use of Oxycodone in Indiana, 2014-2015. *N Engl J Med* 2016

Such networks can become important tools for epidemiologists, in this case during an eventually controlled HIV/AIDS epidemic in Indiana. The interplay between sexual connection and needle sharing by IV drug users pretty much defines the epidemic. Practice question: What is the value of studying networks of sexual contacts for public health?

It allows the identification of individuals at particular risk of spreading infection to large numbers of others.

Number of sexual partners?

Number of sexual partners in lifetime

Median number of opposite-sex partners in lifetime among sexually experienced men and women aged 20-49 years of age 2002, 2006-2010 and 2011-2013:

	2002 ^a	2006-2010 ^b	2011-2013 ^c
Men	4.7	4.0	4.1 (94%)
Women	3.8	3.3	4.2 (98%)

Sources:
^aBehavioral Data Site, Table 20 and 21
^bSpecial tabulation by NCHS

Percentage of men and women aged 20-49 years of age who have had 10 or more opposite-sex sexual partners in lifetime, 2002, 2006-2010 and 2011-2013:

	2002 ^a	2006-2010 ^b	2011-2013 ^c
Men	23.2%	21.6%	23.3% (97%)
Women	9.2%	9.6%	10.3% (95%)

Sources:
^aBehavioral Data Site, Table 20 and 21
^bCharles A. Cooper, CE, MPhD, MD, Social Behavior, Sexual Attraction, and Sexual Identity in the United States: Data from the 2006-2010 National Survey of Family Growth. In: Kinship, Intergenerational Mobility of Population, International Journal on the Demography of Society, Volume VI, Springer Science and Business Media Corporation, 2013, 45-46. Available upon request at http://dx.doi.org/10.1007/978-94-007-5111-1_4
^cSpecial tabulation by NCHS

NOTE: Includes partners with whom respondent had any type of sexual contact (vaginal, oral, or anal)

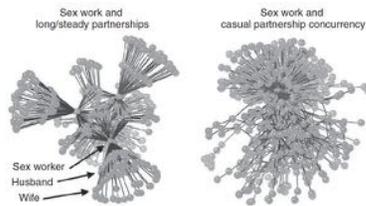


Ben Barres

CDC website

Self reported number of sexual partners is slightly higher for males than for females. There is evidence for stronger sexual drive in males. Transsexual individuals report changes in sex drive towards higher when going from F to M and towards lower when going from M to F. Patches with testosterone administered to M to F transsexual can be used to adjust sex drive upwards. Dr. Ben Barres, an eminent neuroscientist at Stanford and a famous LGBTQ activist.

Highly connected nodes?



Roel Bakker, Erasmus MC, Rotterdam.

Sexual contact networks around sex workers in the Netherlands. Individual sex workers can be hyperconnected and play important roles in the spread of STIs.

Aka and Ngandu of Central Africa (DRC)



Barry and Bonnie Hewlett: no evidence of homosexuality or masturbation (not part of the cultural model of sexuality).

Couples report having sex multiple times a night to "look for children" and nourish the fetus.

A woman who is already pregnant will see having intercourse as contributing to the health of her fetus.

Bonnie and Barry Hewlett, two Seattle based anthropologists have been studying the Aka pygmies and their Bantu neighbors, the Ngandu for many years.

Sexual Activity and Pair Bonding?

What fraction of humans enjoy sexual activity without pair bonding?

What can we learn from US (WEIRD) hookup culture?

Shift in openness and acceptance of uncommitted sex?

There's a stranger in my bed
There's a pounding in my head
Glitter all over the room
Pink flamingos in the pool
I smell like a number
DJ's passed out in the yard
Barbies on the barbeque
Is this a hickey or a bruise

—Last Friday Night (T.G.I.F.) (Perry, Gottwald, Martin, & McKee, 2011)

Hookup culture in the US leading to shifts in acceptance of non-strictly pair-bonded binary gender roles?

Polyamory



Advocates of polyamory in San Francisco

Small numbers of people identify as polyamorous and are happy to advocate for more polyamory.

Sexual Jealousy

Sexual jealousy leads to tremendous destruction, from humiliation to homicide.

Sex-differentiated design features of jealousy?

Cultures in tropical paradises that are entirely free of jealousy exist only in the romantic minds of optimistic anthropologists, and in fact have never been found (Brown, 1991; Freeman, 1983).

A problem plaguing social experiments with open relationships and polyamory remains the widespread existence of sexual jealousy. Sexual jealousy has been observed across cultures and is certainly not simply the product of capitalism or abrahamic religions..... Cultural norms can do much to amplify the potential of harm done by sexual jealousy.

Sexual Jealousy, emotional jealousy

Table 1. Sex Differentiated Design Features of Sexual Jealousy

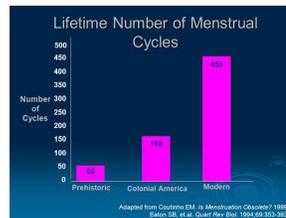
Relative Upset About Sexual and Emotional Aspects of Infidelity
Men more than women give more weight to sexual aspects of infidelity.
Women more than men give more weight to emotional aspects of infidelity.
Cross-cultural Robustness of Relative Upset About Aspects of Infidelity
Germany, the Netherlands, Korea, Japan (Buss, Anglim, Oshio, & Buss, 1996), Brazil (de Souza et al., 2006), England (Buss, Caprè, & Varamba, 2004), Romania (Buss et al., 2004), Sweden (Blackburn & Knutik, 1999), Norway (Kerane, Nordvik, Andreassen, Bussnes, & Fallesen, 2011), Spain (Fernandez et al., 2007), Chile (Fernandez, Sierra, Zubeidat, & Vera-Villanova, 2006), and Poland (Whitty & O'Leary, 2006).
Cognitive Design Features of Sexual Jealousy
Men preferentially process cues to sexual infidelity.
Women preferentially process cues to emotional infidelity.
Men more quickly process cues to sexual infidelity.
Women more quickly process cues to emotional infidelity.
Men show greater memorial recall of cues to sexual infidelity.
Women show greater memorial recall of cues to emotional infidelity.
Physiological Design Features of Sexual Jealousy
Men show greater EEG, EMG, heart rate, and skin temperature when imagining a partner having sexual intercourse with a rival.
Women show greater EEG, EMG, heart rate, and skin temperature when imagining a partner falling in love with a rival.
fMRI study shows sex-differentiated pattern of brain activation to sexual versus emotional infidelity.

Buss, D. *Psychological Topics* 2013

Male and female sexual jealousy, may differ, but how much and in what ways is difficult to study.

Similarly sexual jealousy in non-heterosexuals has not been widely studied yet. There are strong indications that sexual jealousy is strongest in heterosexual males.

Female reproductive cycles then and now

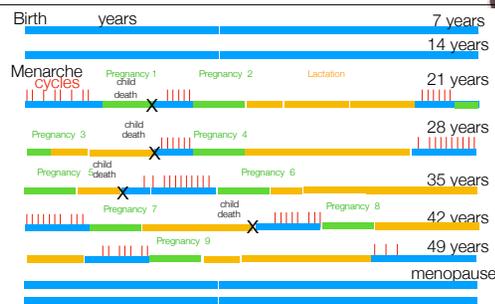


One of the biggest changes in biology over the last 10 thousand years: the total number of menstrual cycles experienced by women between menarche and menopause.

With the control of fertility through contraceptives and pregnancy termination, the total number of cycles experienced has massively increased.

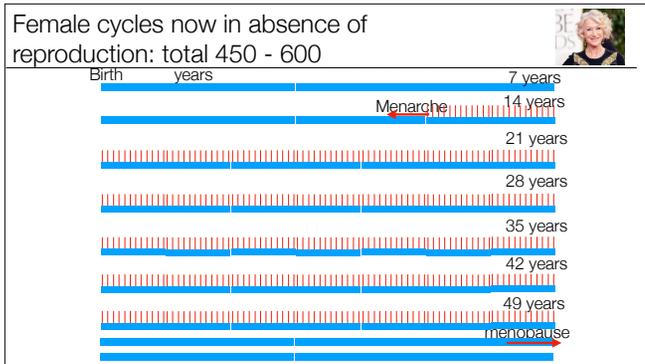
Practice question: What aspect of female reproductive life has most changes between prehistoric and modern times? The lifetime number of menstrual cycles.

Female reproductive cycles in natural fertility women: total: 73

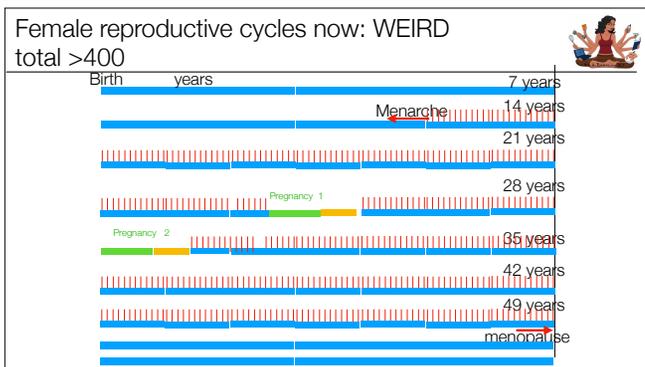


typical life course for a natural fertility foraging woman.

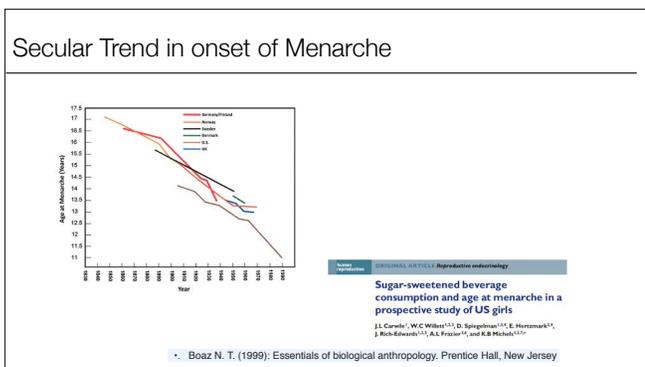
long lactational amenorrhea drastically reduces the total number of cycles.



Typical life course for a modern woman who is childless.

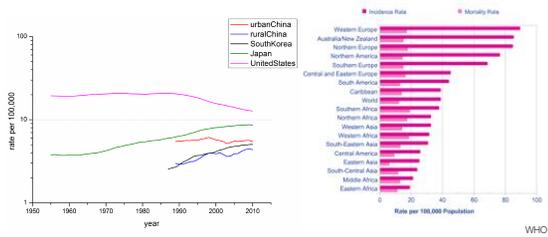


Typical life course for woman in the industrialized world who has two children and does not breastfeed each for more than a couple of months.



Caloric input correlates directly with the onset of menarche.

Breast cancer



Wang et al. Secular Trends of Breast Cancer in China, South Korea, Japan and the United States: Application of the Age-Period-Cohort Analysis
Int. J. Environ. Res. Public Health 2015

Changing rates of female breast cancer.

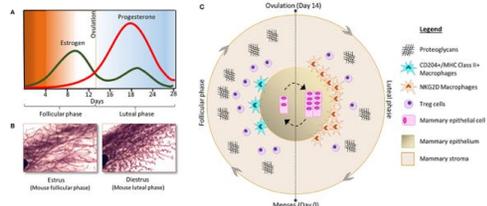
Breastfeeding lowers risk of cancer



breast feeding is associated with lower rates of breast cancer.

Practice question: How could breastfeeding reduce the risk of breast cancer?
 Regular and prolonged breast-feeding inhibits ovulation and menstrual cycles. Each additional cycle causes tissue growth in the breast and is an extra opportunity for cancer causing mutations to occur.

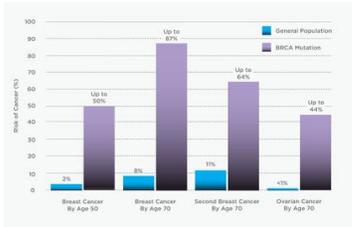
Breastfeeding lowers risk of cancer



Atashgaran, V, et al. Dissecting the Biology of Menstrual Cycle-Associated Breast Cancer Risk, *Frontiers in Oncology* 2016

Radical changes in tissue organization of mammalian milk ducts associated with each ovulation. Expansions of epithelial cell numbers with each cycle accompanied by changes in molecular composition and immune milieu.

Genetic risks of breast cancer



BRCA 1 and 2 genes: tumor suppressor genes: DNA repair, double stranded breaks

Genetic predisposition, such as mutation at the two BRCA genes can massively increase the risk for breast cancer.

These genes are crucial for maintaining efficient DNA repair and losing the function of one of two copies is sufficient for the increase in cancer risk.

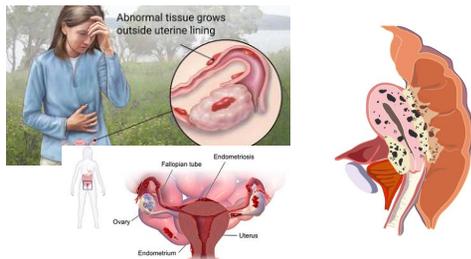
The uterus, our first home!



Our first home, the uterus of our mothers. This is a model used at an IVF clinic to inform patients.

It shows endometriosis, polyps, and polycystic ovary syndrome (on the left)

Endometriosis



Lindheim S.R., Glenn T., Gagneux P., Maxwell R.A., Yallic, J.L. 2018 Current Challenges in the Diagnosis of Deep Infiltrating Endometriosis. *Androl Gynecol: Curr Res*

Endometriosis is a dysregulation of the growth of the lining of the uterus. The cells of this lining can form invasive growths in various organs and cause intense pain as well as loss of fertility.

Practice question: Why is endometriosis called endometriosis?

Because it involves spread and uncontrolled growth of uterine lining tissue (endometrium).

Menstruation: Contribution to Anemia

Humans have a much higher blood volume lost during menstruation

Causes anemia in many women

Iron deficiency can be advantageous against bacterial infection



Two women dancing. Rock engraving from the Upper Yule River, Pilbara, Western Australia. ~20y old

Nutritional iron deficiency: an evolutionary perspective. Denic, Srdjan, and Agarwal Mukesh M. *Nutrition*, 2007 Jul-Aug, Volume 23, Issue 7-8, p.603-14, (2007)

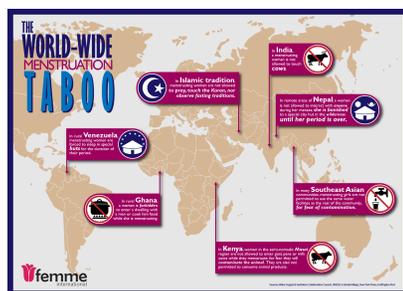
The evolution of endometrial cycles and menstruation. Strassmann, B I. *O Rev Biol*, 1996 Jun, Volume 71, Issue 2, p.181-220, (1996)

Human blood loss during menstruation is exceptionally large for humans. Enough blood can be lost that it causes anemia (insufficient blood due to lack of iron).

Practice question: How could menstruation contribute to anemia?

Blood loss associated lack of iron.

Menstruation: cultural constraints

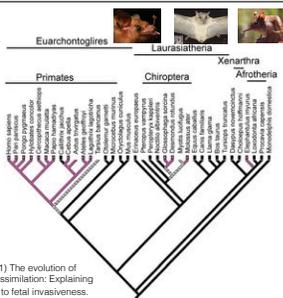


social
(cultural)
evolution!

Many traditional cultures have menstruation taboos. These are cultural norms that prohibit menstruating women from doing a whole range of things: from touching sacred books or sacred cows, to sharing water faucets or cooking for others. These likely represent good examples of cultural norms with zero adaptive or even maladaptive values.

Menstruation: Adaptation or side effect?

Menstruation is relatively rare among mammals. Common in species with invasive placentas and "expensive" young and spontaneous ovulation.

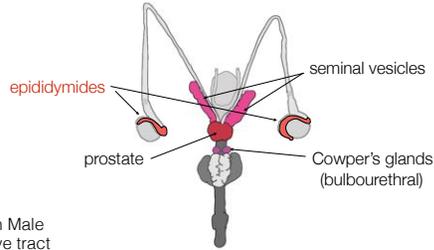


Emera D, Romero R, Wagner G (2011) The evolution of menstruation: A new model for genetic assimilation: Explaining molecular origins of maternal responses to fetal invasiveness. *Biosays* 34(1):26-35.

The reason for why human menstruation is not completely understood. Among mammals, the other lineages that seem to have large blood loss all share invasive placentas and spontaneous ovulation.

Male accessory reproductive cancers:

Men most often die with or of enlarged prostate!



Orangutan Male reproductive tract

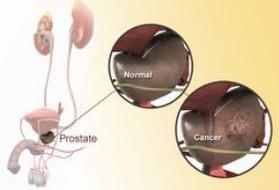
After Dixson 1990

Male reproductive cancers are not linked to sexual activity. Most males tend to suffer from an enlarged prostate gland. This large gland secretes most of the volume of semen to transport sperm during ejaculation.

Practice question: What is the function of the prostate?
it is a major gland producing much of the seminal fluid for ejaculation.

Male accessory glands:

Ejaculation frequency and prostate cancer



Leitzmann MF, Platz EA, Stampfer MJ, et al. Ejaculation Frequency and Subsequent Risk of Prostate Cancer. *Journal of the American Medical Association* 2004
Giles GG, Severi G, English ER, et al. Sexual Factors and Prostate Cancer. *BJU International* 2003

Ejaculation frequency appears slightly protective against prostate cancer.

Practice question: Is ejaculation frequency associated with higher prostate cancer?

No, the contrary.

Nymphomania and Satyriasis



The 1896 painting 'Hylas and the Nymphs' (pictured above) by English artist John William Waterhouse depicts a scene from ancient mythology in which a group of feasting naked nymphs seduce a young man to his death.
Manchester Gallery



Hypersexuality, Sex Addiction

Individuals with hyper-sexuality or sex addiction often seek help for trying to reduce their sexual urges.

Anaphrodisiacs



Vitis agnus-castus, also called *vitis*, chestnut tree.

opiates
alcohol
coriander
hops
licorice

DES (diethyl stilbistrol)
a non steroidal estrogen

There are natural products that act as anaphrodisiacs and synthetic drugs that can chemically obliterate sex drive.

Asexuality (religious)



Mount Athos Monastery, Greece



Individuals can lead an asexual life such as the Greek orthodox monks on Mount Athos, where females of any species are not allowed.....the temptation must apparently remain even in very devoted monks.

The statue is of a satyre mating with a goat. We will address the subject of zoophilia in a later lecture.

Asexuality (secular)

“Herbivore men”
草食(系)男子
Sōshoku(-kei)
danshi



Arm's length: 45% of Japanese women aged 16-24 are 'not interested in or despise sexual contact'. More than a quarter of men feel the same way.

celibacy syndrome?

2012 adult incontinence nappies outsold diapers

“Herbivore men” 草食(系)男子 Sōshoku(-kei) danshi

Surveys of single Japanese men conducted in 2010 found that 61% of men in their 20s and 70% of men in their 30s considered themselves to be “ herbivore men”

Summary



Sex is a powerful driver of human behavior (Freud)

Unlike other primates, humans have further separated sex from reproduction by culture and technology.

There is probably no "good for the species", rather only good for the individuals and the genes he/she carries.

There are only two eusocial mammals (mole rats).

Humans are affecting their own evolution by social/cultural evolution.

Sex and sexual behavior are a big part of culture.

The high number of female menstrual cycles is a cultural product and it strongly affects women's health.

Polyamory exists, but sexual jealousy is a very destructive force.

Societies have cultural models of sexuality.

Humans can exhibit both, exaggerated or lack of sexuality.
