Sexual Differentiation

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Goals

• Why sex

• How sex is determined (we think)

• Sex and the brain!
  • Or what I do for a living
Why have sexes?

• Many species reproduce asexually

Starfishes do it by fragmenting
Why have sexes?

- Many species reproduce asexually

Hydras bud (so does yeast!)
Why have sexes?

The asexual, all-female whiptail lizard reproduces via parthenogenesis.
Why have sexes?
Why have two sexes?

NEWS ITEM: SCIENTISTS HAVE LEARNED HOW TO CLONE CATS
So why have sexes?

- Genetic recombination
A caveat .....
Some even have more than 2!

The Plainfin Midshipman fish has 3 reproductive phenotypes
And some are in between

**Caenorhabditis elegans** is a self-fertilizing hermaphrodite that occasionally produces males (0.1%)
Goals

• Why sex – to increase genetic diversity!

• How is sex determined?

• Sex and the brain!
  • Or what I do for a living
Sexual determination:

• What determines one’s sex?
  • (please vote!)
• Environment?
• Genetics?
• Hormones?
• It’s complicated!
Environment!

• If you are a turtle .....
Genetics

• For most vertebrate species
How do genetics contribute?

http://www.visembryo.com/story4072.html
Sry creates testis
SRY is the Male Determination Factor

Page et al. Zfy/Zfx
Berta et al. SRY

HMG Transcription Factor
Binds to sry element of Sertoli cell MIS/MRF gene (stimulates) & of Leydig cell P450 aromatase gene (inhibits) [1993]

Cytogenetic localization of SRY region (after McLaren)

Sry (14 kb DNA fragment)

1
2a
2b
XX embryo
13 days

2
Hormones –
Testosterone creates males

Perinatal treatment with estrogen or androgen can eliminate sex differences in behavior
Proof of concept – AIS

All of these women are XY and lack the androgen receptor
Goals

• Why sex – to increase genetic diversity!

• How is sex determined – by genetics and hormones – (if you’re mammalian)

• Sex and the brain!
  • Or what I do for a living
What about the brain?

Hypothesis

If brain controls behavior then
Different behavior = different brain!
Fernando Nottebohm

Zebra finches – males sing, females do not
Nottebohm looked at the parts of the brain that regulate song.
RA (and HVC) are bigger in males than females
Roger Gorski
Rat preoptic area is sexually dimorphic
Proof of concept—hormones that alter behavior also alter the brain

C Adult female exposed to:
Testosterone

Diethylstilbestrol

AC  SDN-POA  OC

SDN-POA  OC
Preoptic area is also different in humans
Sex differences in the human brain – more than the preoptic area!
Caveat: Lawrence Summers

Summers resigned as Harvard's president in the wake of a no-confidence vote by Harvard faculty in part due to a 2005 speech in which he suggested that the under-representation of women in science and engineering could be due to a "different availability of aptitude at the high end", and less to patterns of discrimination and socialization.
Conducted in 1960, it included more than 73,000 15 year-olds, both students and nonstudents.
Goals

• Why sex – to increase genetic diversity!

• How is sex determined – by genetics and hormones – (if you’re mammalian)

• Sex and the brain – a lot of the human brain is dimorphic.
Why should we care?

Because sex differences have profound effects in the clinic
Women and Men: 10 Differences that Make a Difference in the clinic

Heart Disease - Heart disease kills 500,000 American women each year-over 50,000 more women than men-and strikes women, on average, 10 years later than men. Women are more likely than men to have a second heart attack within a year of the first one.

Depression - Women are 2-3 times more likely than men to suffer from depression in part because women's brains make less of the neurotransmitter serotonin.

Osteoporosis - Women comprise 80 percent of the population suffering from osteoporosis, which is attributable to a higher rate of lost bone mass.

Lung Cancer - Women smokers are more likely to develop lung cancer than men smokers, at the same level of exposure. Women are more susceptible to the carcinogens in cigarettes.

STDs - Women are 2 times more likely than men to contract a sexually transmitted disease, and 10 times more likely to contract HIV during unprotected sex with an infected partner.
Women and Men: 10 Differences (cont’d)

Anesthesia - Women tend to wake up from anesthesia more quickly than men—an average of 7 minutes for women and 11 minutes for men.

Drug Reactions - Even common drugs like antihistamines and antibiotic drugs can cause different reactions and side effects in women and men.

Autoimmune Disease - 3 out of 4 people suffering from autoimmune diseases, such as multiple sclerosis, rheumatoid arthritis, and lupus, are women.

Alcohol - Women produce less of the gastric enzyme that breaks down ethanol in the stomach. Therefore, after consuming the same amount of alcohol, women have higher blood alcohol content than men—even allowing for size differences.

Pain - Some pain medications (known as kappa-opiates) are far more effective in relieving pain in women than in men.

http://www.womens-health.org/
Thank you for your attention!

Any questions?!