

Evolution of Sex, Part 1.

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Biology of Sex

No area of evolutionary biology offers a more fascinating mixture of strange phenomena ...

than the evolution of sex ...

(Stearns, 1987)

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Why does sexual reproduction exist?

Why has it persisted for so long?

What are the benefits/disadvantages of sexual vs asexual reproduction?

Why are there two biological sexes (male/female)?

Is sexual reproduction cooperative or competitive?

Who benefits most from sex: males or females?

Would humans exist in a world without sexual reproduction?



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Reading Assignments (Online Syllabus):

1. [Why Sex - The advantages of sex \(PBS series\)](#)
2. [The Trouble With Sex](#)
3. [Battle of the Sexes Pgs 13 - 18](#)
4. [Why the Y?](#)
5. [Male Sex Chromosome to Stick Around](#)
6. [Bowerbirds](#)
7. [Understanding Evolution](#)
8. [Rediscovering Biology: Sex & Gender Pgs 1 - 4](#)

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Meaning of Sex:

- From Latin "**secare**" = means to cut or divide something that was once whole.
- Modern term for sex: "**Syngamy**" = union of gametes
(eggs & sperm).

Ques: Like male and female?

Did distinct male and female of species always exist??

This implies that two distinct sexes share a common ancestry, and have become separated (for better or worse)

Since then we've been doing everything possible to hook up again!

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From biological standpoint the function of life is to survive long enough to reproduce & pass on genes.

- > To reach this goal need to
 - increase chances of reproducing
 - have increased survival of offspring.

Collectively this is called "**Evolutionary Fitness**"

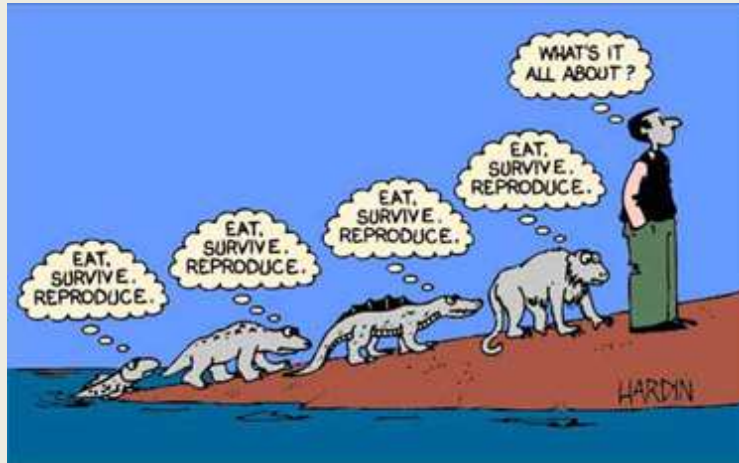
= the most "fit" organisms have the most surviving offspring.

"The egg is the hen's way of making more hens." (Samuel Butler)

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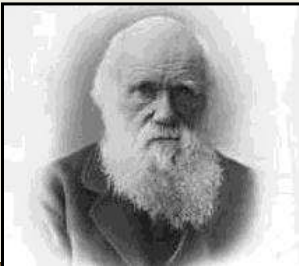
Reproduction is the name of the game, and sex is the way we do it.



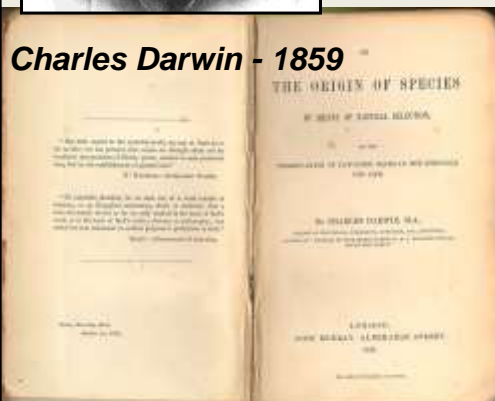
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Evolution & Natural Selection – Pgs 183 - 187



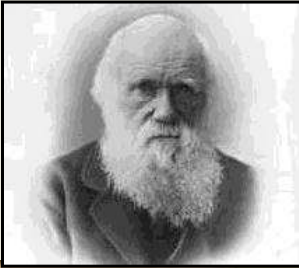
Evolution = slow change in characteristics of populations over long periods of time.
 [Need reproduction for evolution to occur]



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Evolution & Natural Selection – Pgs 183 187



Evolution = _____

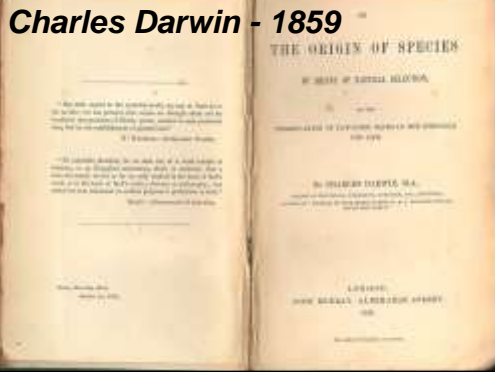
[Need *reproduction* for evolution to occur]



Natural Selection

Theory refined by Charles Darwin.

= organisms having
traits that offer an
advantage to survival
& reproduction in a
particular environment.



Charles Darwin - 1859

Example of Natural Selection - Darwin's Galapagos Finches

Different islands in the Galapagos have slightly different environments. Finches on diff. islands have slightly diff. physical traits (are diff. species), which evolved to exploit available resources. (Ex. diff. beak shapes and sizes)



Certhidea olivacea
Probing bill, insect eater
Feeds in trees



Camarhynchus pallidus
Probing bill, insect eater
Uses twig or cactus spine
to probe insects from cactus

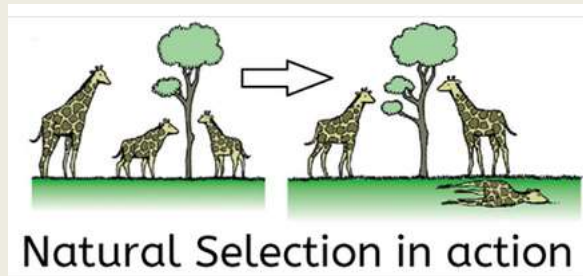


Camarhynchus heliobates
Grasping bill, insect eater
Feeds in trees



Camarhynchus crassirostris
Crushing bill, cactus seed eater

Example of Natural Selection – Giraffe's long neck



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Example of Natural Selection – Crypsis (= camouflage)



Cryptic prey stay hidden from predators to avoid being eaten,

or

Cryptic predators hide from their prey in order to sneak up on them, or ambush them.

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Example of Natural Selection – Industrial melanism of the Peppered moth.



Industrial melanism in the peppered moth, first noticed by English geneticist Henry Kettlewell. He observed that whereas in rural areas peppered moths were light in colour to camouflage them against the lichens, in industrial areas where the tree trunks were dirtied with soot, peppered moths were darker. Natural selection favoured the darker mutation in industrial areas because it offered better camouflage there, so it had become widespread, whereas in rural areas the darker mutant was highly visible against the lighter tree trunks and so was easy prey to insect feeders.

“**Crypsis**” = coloration and/or morphology of animals that makes them hidden (cryptic) in their environment & avoid being eaten.

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Example of Natural Selection – Peacock??????



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The flashy male Peacock was always a thorn in Darwin's side.

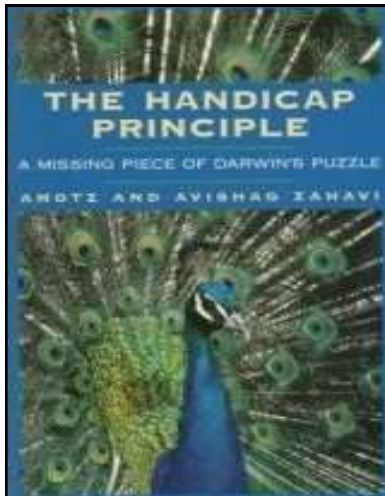
This animal was definitely NOT CRYPTIC!

- Very visible means more visible to predators.
- Excessively long tail feathers are heavy and make flying difficult (more difficult to escape predators)
- This seems like a handicap. So ... WHY??

What could possibly make this handicap worthwhile?



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The Handicap Principle

By Amotz Zahavi

"An individual with a well developed sexually selected character [such as a peacock's flashy tail] is an individual which has survived a test. A female which could discriminate between a male possessing a sexually selected character, from one without it, can discriminate between a male which has passed a test and one which has not been tested. Females which selected males with the most developed characters can be sure that they have selected from among the best genotypes of the male population." (Zahavi 1975)

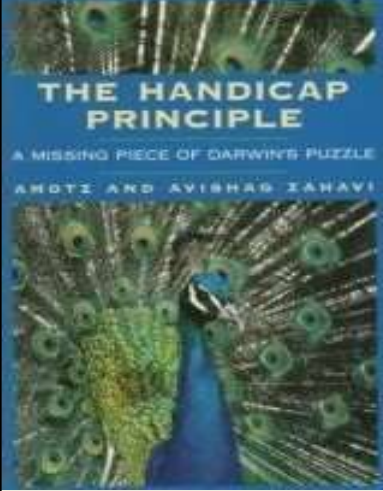
*End of lecture
1/11/24*

Source:

https://en.wikipedia.org/wiki/Handicap_principle

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The Handicap Principle
By Amotz Zahavi

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Source:
https://en.wikipedia.org/wiki/Handicap_principle

The Handicap Principle: A male with a exaggerated sexually selected trait, which has SURVIVED having that trait, despite the difficulties & dangers (its handicap), must be EXTREMELY FIT! Thus, be extremely attractive and chosen preferentially by females through sexual selection.


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“Sexual Selection”

= a form of natural selection in which a trait is preserved in a population IF it's deemed attractive by opposite sex.

Click [HERE](#) for YouTube video example: Male Peacock Dance (2 min)



Usually
it's
females
choosing
males.

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Sexual Selection & “Female Choice”

A very controversial topic in Darwin’s time was “[Female Choice](#)”

This did not set well with the Catholic church which viewed human females as entirely passive sexually and males do the choosing.

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Sexual Selection & “Female Choice”

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Female choice = females choose to mate w/male having most attractive traits.
 > females bear most of cost of reproduction (especially mammals). Pregnancy & birth are dangerous. Nursing is energetically expensive. Offspring take time to become independent of mom.

> females want best genes for reproducing because ...



“Eggs are expensive while sperm is cheap.”

Example: Sexually mature human female can, at most, ovulate 500 eggs in her lifetime. Not all will be fertilized. Not all embryos make it to birth. Whereas sexually mature male can produce millions of sperm a day (100 million in an ejaculate).

Result: Females are choosy

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Example of Sexual Selection = Giraffe's long neck

Necks
for
SEX!



(Click image for YouTube video of males giraffes fighting for breeding rights. 1.20 min)

Male giraffes fight with their necks because it's the most powerful and maneuverable weapon they have. Bulls fight to establish dominance or to win the right to mate with the females (cows) in a particular area. Necking in their world is the most violent and unpleasant experience they're ever likely to engage in. These fights are very serious, with the giraffes repeatedly slamming their necks against one another with the intent to cause real injury. They may also try a debilitating kick with their hooves.

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Example of "Female Choice"

Birds of paradise - males trying to be pretty



Click [HERE](#) for YouTube video of male birds paradise sexual displays.

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Example of “Female Choice”

David Attenborough in *Planet Earth* series



Click [HERE](#) for YouTube video:
Superb Bird of Paradise video
(~ 2min)



Click [HERE](#) for YouTube
video: Bulwers pheasant
video (3.24)

Think humans are different??

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Think humans are different??

Nigerian Wodaabe men compete in “beauty pageants” to impress the ladies.
Click [HERE](#) for YouTube video.



Video
2.54 min



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Think humans are different??

Remember the 2013 VMA Show?
(Miley Cyrus & Robin Thicke)

Click [HERE](#) for YouTube video.



Video
1.06 min

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Think humans are different??

Still not convinced??? [This one's a little crazy! But, hey, let's go there. Click [HERE](#) for YouTube video]



How to impress a woman

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Example of “Female Choice”



Male Bowerbirds (Click [HERE](#) for YouTube video) create elaborate nests, decorated with objects that females find attractive. If he can attract a female to his bower, the Bowerbird begins an intricate dance and song to entice female to mate with him. But the female decides whether it meets her standards.

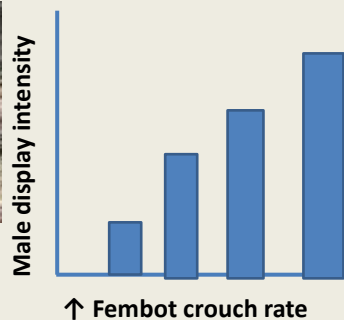
See reading assign “[Bowerbirds](#)” (National Geographic)

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Female bower bird “fembots” created by biologist Gail Patricelli Univ. of Maryland.

The more the mechanical female bird crouched, the more frequently and intensely the male Bower bird displayed. Demonstrated that female behavior drives male’s behavior.

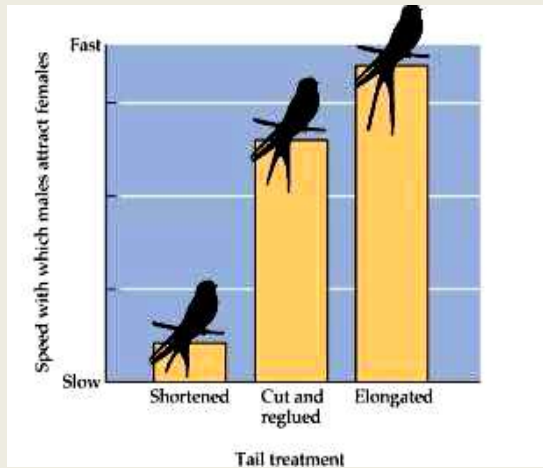


Fembot with remote control

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“Female Choice” Experiments:

1. Tail Length Experiments: with African Widow birds and Barn swallows



Widow bird male has extremely long tail feathers.

Researchers (Malte Anderson)

- Cut tail feathers and glued them on to birds producing varying lengths of tails.
- Recorded female choice for these males having diff. tail lengths.

Results: males with longest tails had greater mating success.

Source: <http://www.biologyreference.com/Se-T/Sexual-Selection.html>

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“Female Choice” Experiments:

2. Parasites & Plumage Experiments

- Birds lacking parasites tend to have better, brighter plumage & are more attractive to females. Have greater fitness.
- Birds with parasites had poorer, duller plumage & less attractive to females. Had lower fitness.



Cockatiel with mites



Healthy Cockatiel

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Sexual Selection & "Female Choice"

Why do male White Tail deer have antlers??

Disadvantages:

- Their big and conspicuous
- They are energetically expensive to grow/maintain
- They get caught in stuff



Advantages:

Signal to females:

- the handicap!
- > male survived ~~to~~
 - > male is healthy (energy)
 - > he is best competitor



Also signal to rival males:

- > I'm bigger, healthier, & stronger than you.



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A sexually selected male "handicap" is a careful balance of disadvantages and advantages.

- More advantage = greater fitness
- More disadvantage = greater chance of death & extinction.

"Runaway Selection" by Ronald Fisher

= Sexually selected handicap traits, chosen by females, can lead to increasingly exaggerated (runaway) male traits that tips the scale to more disadvantage.

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Runaway Selection

Reading assign. "[Battle of the Sexes](#)" Pgs 16-17

Example: The Irish Elk

The Irish Elk – stood 7 ft at the shoulders with antlers that stretched 12 ft across and weighed nearly 90 lbs!

Disadvantages proved too great. It became extinct.



Sources:

http://en.wikipedia.org/wiki/Irish_elk

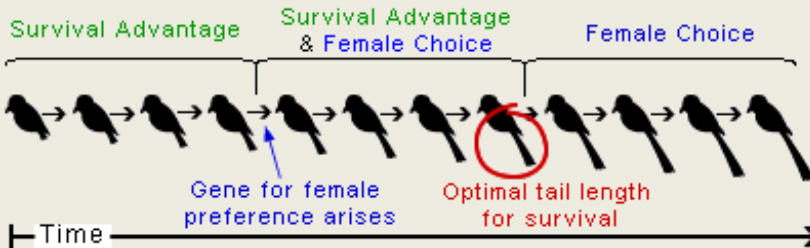
<http://evolution.berkeley.edu/evosite/evo101/IIIE3aRunawayselec2.shtml>

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Runaway Selection Example: Widow birds and tail length

Tail Length increases because of...



"... the process may run out of control, until the male trait becomes so exaggerated that it is disadvantageous. In other words, female preference, instead of survival advantage, may begin to drive the evolution of ever-longer tails, until males are encumbered by showy plumage that no longer helps them avoid predation."

Male Traits	Genetic Quality	
Short tail (Cheap)	Good	Alive
Long tail (Costly)	Bad	Dead

Handwritten notes:
 - Next to 'Good': mating success bad
 - Next to 'Bad': too long - disadvantage
 - A blue circle highlights the 'Alive' cell for 'Long tail (Costly)'.

Source:

<http://evolution.berkeley.edu/evosite/evo101/IIIE3aRunawayselec2.shtml>

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Runaway Selection – Male guppies & risky behavior

Reading assign. "[Battle of the Sexes](#)" Pgs 16-17



Male guppy

Example:

Trinidadian male guppies that display more boldness (approach predators) are chosen as mates by more females.

Risky behavior of bold male guppies pays off w/increased fitness.

But the males aren't stupid! When no females are present they don't go anywhere near a predator! They only display boldness when female guppies present.

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Sexual Selection (by males) for traits in females



***permanently enlarged breasts
in women***

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Sexual Selection (by males) for traits in females



permanently enlarged breasts in women

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Sexual Selection (by males) for traits in females

permanently enlarged breasts in women



Ariana Grande

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Sexual Selection (by males) for traits in females

*permanently enlarged
breasts in women*



Ariana Grande

Not seen in other female primates. So, WHY??

Signals:

- > Reproductive maturity
- > Have enough fat stores in body
- > Also “hides” female’s stage of reproduction.

(Primates only develop breasts when pregnant & nursing. Mature human female –cannot always tell.)

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What About Breast Size?



Marilyn Monroe



Miley Cyrus & Katy Perry



Nicki Minaj

(Do bigger breast provide more milk?)

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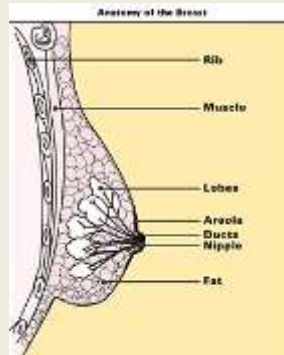
What About Breast Size?



(Do bigger breasts provide more/better milk?)

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What About Breast Size?



(Do bigger breasts provide more/better milk?)

No!

Fat content of breast varies, glandular content usually does not

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Sexual Selection (by males) for traits in females

Adult female body shape due to fat deposits at puberty. Fat stores needed to fuel costs of pregnancy and lactation.

Need 7% body fat to menstruate

Need 22% body fat for pregnancy



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What About Penis Size?



(Does size matter?)

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Penis Size in Primates:



**Smallest
penis**

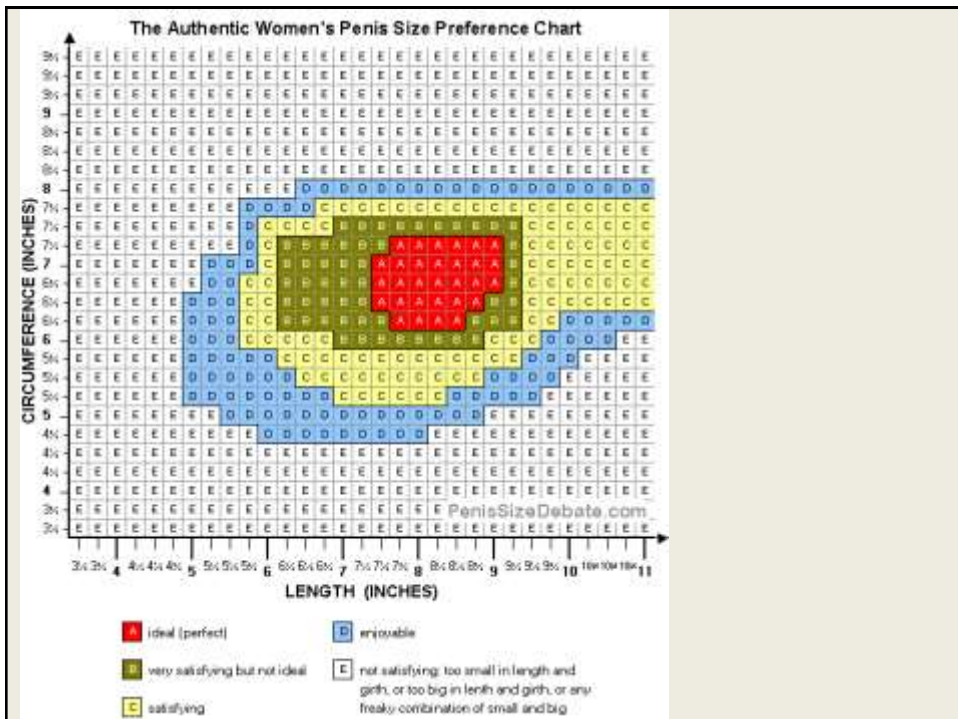


**Medium
penis**

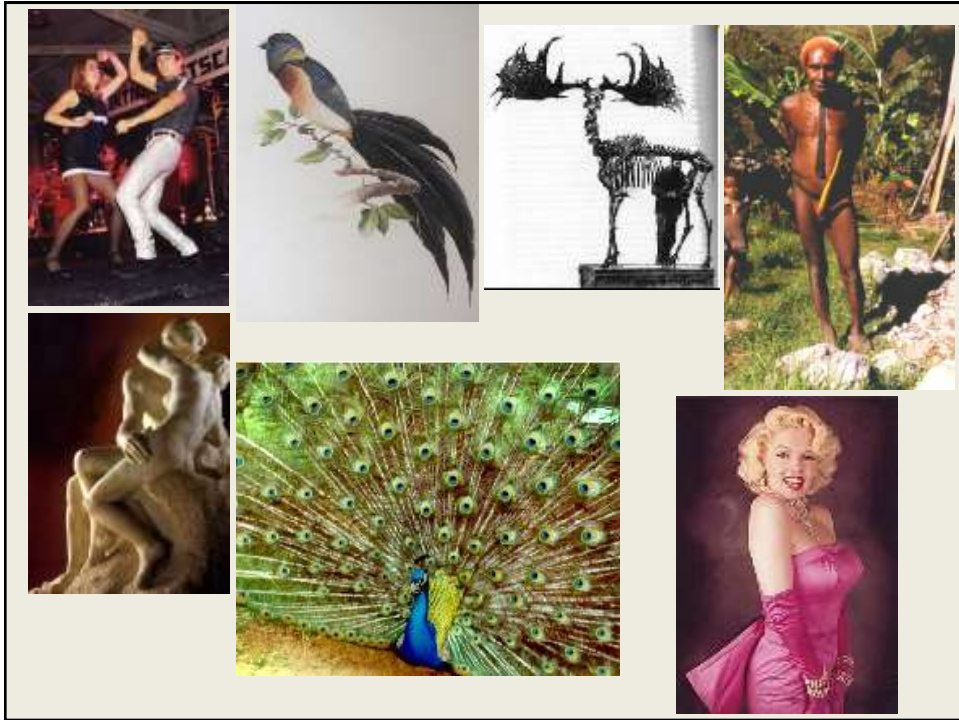


**Biggest
penis**

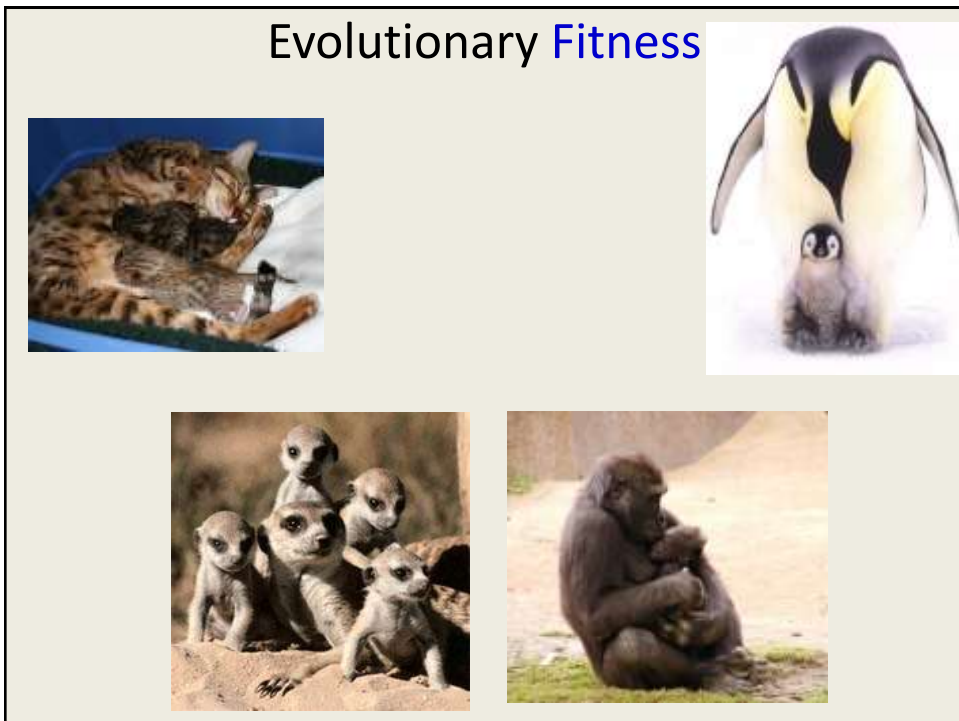
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Let's Play the Evolutionary Fitness Game:

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