SGCEP BIOL 1010K
Introduction to Biology I
Spring 2012 Sections 20585 & 20586

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And now a short diversion before the main lecture . . . .
Many of you wondered about those human sexuality extra credit essay questions.
So let’s talk about them for a bit.
The human female is unique among most mammals in having permanently (beyond adolescence) prominent breasts. Other mammals only develop engorged breasts while actually lactating (providing milk to offspring). However, female humans selectively deposit adipose tissue around the mammary glands during puberty to create enlarged breasts that persist throughout the remainder of her life.

Why could this be? Seems like conspicuous breasts would be selected against when they weren’t needed — they just get in the way. You need to use sound evolutionary reasoning — try to think of any evolutionary advantages this may confer the human species (and therefore, it’s genes).
“Why” answers could include . . .

Any of at least these four commonly touted hypotheses:

1. Desmond Morris was one of the first to comment on this in his mid-60’s classic *The Naked Ape*. He thinks that human female breasts are an example of sexual signaling, that goes right along with our nakedness, and that accompanies the evolution of bipedalism. He postulates that the female bosom is an example of self-mimicry — mimicking the more standard rear buttock display of other sexually receptive primates. Leonard Shlain (*Sex, Time and Power, 2003*) agrees. Hmmmmm, interesting . . . .

2. Less sexually charged, but also serving as a signal, is the idea that breasts indicate to males that their potential mate has a good ability to acquire and store calories. And along the same line, that breasts that are ‘just right’ (the “Goldilocks hypothesis”) indicate a female of an appropriate age, nubility, fertility, and health for mating (reproductive potential). Too asymmetrical, too unhealthy; too small, too young; too saggy, too old!
Human female conspicuous breasts, cont.

And that because it is easier to judge things like symmetry and sagging with larger breasts, males selected for larger breasts! So, yes, bigger breasts reflect the females ability to store fat, and, therefore, advertise that vigor, as well as her age.

3. An extension of this is the “deception hypothesis” that posits that our ancestral males were just stupid, and thought that big breasts equated with being able to provide lots of milk to offspring, so they selected mates with bigger and bigger breasts.

4. Another idea is known as the “handicap principle.” Just like a peacock’s tail, big breasts may not really be that desirable of a thing (to the female in this case), but males just happen to really like them!
And to finish up the breast issue . . .

Regardless, it’s most likely some combination of sexual selection mechanisms.

Whatever the combination of factors is that led to the evolution of the human female breast, it had nothing to do with the amount of milk available for suckling. If this were true, then, sure, bustier females would be selected as more preferential mates to better nourish potential offspring. However, this hasn’t happened in other mammals, and, furthermore, there is absolutely no correlation between breast size and milk production! Bigger breasts don’t have more mammary glandular tissue, they have more adipose tissue (fat).
The human female is unique among nearly all mammals in concealing her ovulation (also known as hidden estrus). As any couple that is trying to conceive very well knows, it is difficult to know whether the female is actually ovulating, and, therefore fecund, that is, able to get pregnant at that time. This is very much in contrast to most of the rest of the mammals; they go into “heat” — most other primates’ genitalia swell and redden, many mammals release pheromones — both the male and the female ‘know’ it’s time!

Why (not how) could this be? You need to use sound evolutionary reasoning — try to think of any evolutionary advantages this may confer the human species (and therefore, it’s genes).

So, “why” answers could include . . .
1. Paternal investment (or the “keep ‘em close” ploy): This is perhaps the most comprehensive and inclusive. The idea is that not having a precise time when sex is solely used for reproduction, and not knowing whether a particular sexual encounter leads to a particular pregnancy, reinforces the pair-bond and leads to increased male contribution to child-rearing. Sex becomes much more than just a mechanism of reproduction. Paradoxically, the same sort of idea works well with cuckoldry as well. The female can keep a good family-man around to help with child-rearing by providing sexual incentives, and yet also be adulterous, without anybody knowing the better.
2. Another good one is just how dangerous human child birth is — babies have really big heads! Call this one the “not tonight honey” idea. Therefore, if females don’t know when they’re ovulating, they don’t know when to abstain from sex to avoid child birth danger.

3. A grisly one is that it helps to avoid infanticide. If the male partner isn’t sure whether it’s his offspring or not, he likely won’t kill it because he thinks it’s some other male’s.

4. Some argue that it’s merely a byproduct of bipedalism — that with a bipedal stance males no longer have female rear ends in view as much, or that it even could have interfered with bipedalism. In my opinion, these ideas are the weakest.
None of these several evolutionary hypotheses of why this trait may have developed...

Involve any sort of technology or clothing or overpopulation or ‘embarrassment’ — the “concealed ovulation” trait (and probably permanently prominent breasts) evolved WAY before any of these had anything to do with humans, a million or so years ago, probably even before Homo sapiens, most likely in Homo erectus/ergaster. It is not a recent change!

An interesting idea, but probably not valid, is it evolved to help prevent predation. This doesn’t work very well, because all sorts of mammals are predated upon.

Another was that we were ‘smart’ or communicative enough to let one another know. But if it’s hidden, it’s hidden — from both males and females. Neither knows.
Furthermore, after glancing over the 20586 essays . . .

I truly need to clear up some terrible misinformation! Several people claimed that human females do go into an obvious ‘heat’ with external genitalia swelling and pheromones. This is SO untrue — they got zero points. Yes, there is good research showing that human estrus isn’t completely hidden; there are subtle signs, including small body temperature changes, but it’s not obvious to either males or females!

But the worst problem was, even though I didn’t ask, nor did I penalize . . .
A whole lot of people claimed that ovulation occurs two to three days before and (or) after your menstrual period. This is blatantly not true, and may partially explain why there are so many teen pregnancies! I have no idea where this idea is coming from, but one woman even claimed her doctor told her. How can such a pernicious lie be so widely held?

Ovulation occurs mid-cycle, on approximately day 14. That is about a week and half to two weeks after your menstrual flow stops, not just a few days after (or before)! You are most able to get pregnant around a four day window centered about that day.
Here's a chart from Wikipedia:

So, again, both traits are most likely the result of some combination of sexual selection mechanisms.

Finally, “there,” “their,” and “they’re” are VERY different words; and the possessive form of a noun has an apostrophe (except its)!

And don’t sweat it — if you gave any sort of logical explanation for the phenomenon I asked about, I’ll give you partial credit. However, since I gave all my classes this sort of extra credit essay opportunity, it will be a while before I get them all graded!
And now the lecture — Biotechnology — ‘Frankenfoods,’ cloning, biomedical miracles, and other fables

There are so many misperceptions in this area; it’s amazing. Humans have been ‘bioengineering’ since they first took in orphan wolves as living partners, since they first noticed that some plants had bigger fruits and they replanted them, since female humans first desired the most virile male in the group! Only that was the slow, ‘natural’ way of evolving by “artificial selection.” Humans knew what worked, and they made more of the type of organism that they liked.
Darwin realized this. He made artificial selection one of his keystone arguments for natural selection as the prime force of evolution.

But now we can do it much faster! Same thing, just at incredibly faster rates, and across species boundaries! And this opened up all sorts of ethical dilemmas. I won’t be discussing the ethics, but I will try to present some of the facts. You can decide for yourself. We’ll start with some of the techniques.
One of the most important techniques is PCR.

- Kary Mullis developed the Polymerase Chain Reaction, PCR, at Cetus Corporation in the mid '80s for which he won the Nobel Prize.

- See Mullis’ fascinating little book Dancing Naked in the Mind Field (1998) for an insightful look into his rather bizarre head.

- It has revolutionized modern molecular biology. From Jurassic Park scenarios in popular novels and movies, to everyday research in countless molecular biology laboratories across the world, to cutting-edge forensic pathology techniques as popularized by television shows such as CSI, PCR is being used to analyze tinier concentrations of DNA than ever before imagined possible.
PCR allows an investigator to analyze any stretch of DNA in any organism where at least some sequence information is known, either in that organism or in related organisms. It can isolate, and amplify up to around a million-fold, just a few molecules of DNA from complex environmental mixtures, even where the DNA is significantly degraded—the ramifications are incredibly far-reaching.

- Very small amounts of DNA are amplified into larger quantities for detailed analysis, including sequencing. It uses . . .
- Repeated cycles of heating to open the helix, then replication with a heat stable polymerase, and then cooling to rejoin the strands.
- The amount of DNA doubles with each cycle. It has a . . .
- Wide variety of applications in forensics, agriculture, veterinary medicine, environmental science, and human health care.
Here's the schematic.

It results in an exponential increase in the number of DNA molecules!
And an animation...

http://www.bio.fsu.edu/~stevet/VSU/animations/Chapter07/polymerase_chain_reaction.swf
And a video . . .

http://www.youtube.com/watch?v=_YgXcJ4n-kQ
But first came DNA sequencing.

* The most widely used technique for DNA sequencing was developed in 1977 by Frederick Sanger, for which he won the Nobel Prize in 1980.

* The process generates a series of DNA fragments that are complementary to the original DNA, and differ from one another by their end bases, because of the random incorporation of modified, "chain-terminating" nucleotides.

* Electrophoresis is used to separate the fragments based on their size. And then...

* Reading those end bases reveals the complete sequence of original DNA.

* Radioactive (originally) or fluorescent (now) labels make it possible to read the sequence.
Newer technologies make use of capillary tubes or multi-well reaction plates rather than gels, but the idea remains the same.

Here's the schematic of this process.

1. Four solutions contain unknown DNA sequence, primers, normal nucleotides (A, C, G, and T), labeled nucleotides, replication enzymes, and a small amount of “terminator” nucleotide.

2. Replication occurs, resulting in fragments of complementary copies of the unknown sequence.

3. Samples are transferred to a gel between two glass plates. Electrodes are connected to both ends of the gel.

4. During electrophoresis, negatively charged phosphate groups are attracted to the positive electrode, causing the DNA fragments to move through the gel. The smaller the fragment, the faster it moves.

5. The fragments are read off by size, and the original sequence can be deduced.
Here's an animation.

http://www.bio.fsu.edu/~stevet/VSU/animations/Chapter07/Sanger_sequencing.swf
And a video . . .

View the full Interactive Tutorial at:
http://www.phgfoundation.org/tutorials/dna/5.html

* http://www.youtube.com/watch?v=oYplbl0qF8
Another newer technology known as Microarray (or ‘chip’) . . .

- Uses short DNA (or RNA) fragments of known sequence immobilized on small glass (or plastic) squares at a known location. There are thousands of such locations on one microarray.

- Unknown sequences will bind if complementary.

- A laser scan of the chip reveals at which known locations fragment binding occurred. This is . . .

- Increasingly common in research, especially for detecting which genes are turned on (or off) in particular cells and tissues at particular times, and it may eventually have applications in tailoring drug treatments and/or diagnosing specific cancers.
Here's the schematic for this. Identifying locations of overlap among the bound sequences reveals the unknown sequence...
All this technology can be used for some pretty cool stuff . . .

* Such as DNA profiling, which can detect genetic differences between individuals.

* Only specific variable regions are considered for this.

* Restriction enzymes, which cut DNA at known patterns, create fragments which are then separated based on size by electrophoresis.

* If two samples differ in the fragments generated, in some cases just by size, in other cases by sequence, they are different people.

* Mitochondrial DNA is often used – mitochondria are only inherited from your mother, so it cannot differentiate between siblings or fathers and sons, but other parts of the genome can.
And a schematic shows how the variant of this based on size works.
And one last animation . . .

http://www.bio.fsu.edu/~stevet/VSU/animations/Chapter07/dna_fingerprinting.swf
Some critical concepts . . .

A “transgenic” organism receives “recombinant” DNA. Restriction enzymes are essential.

Recombinant DNA is genetic material spliced together from multiple organisms. Transgenic bacteria can make drugs. Transgenic crops can resist disease. And transgenic human disease models further our understanding of disease processes.
And then the piece of donor DNA is stuck into some piece of recipient DNA with the splice sealed by ligase. Bang, recombinant DNA!
One of the most common applications is to put the recombinant plasmid into a bacterium, which can crank out all sorts of the protein that the original gene encoded.
And it can also be done in plants with **Agrobacterium**, viruses or ‘gene guns’...
Another, even more controversial use of biotechnology is “gene therapy.”

Where genes are introduced into an organism in an attempt to cure some genetic disease process.

In some forms of gene therapy the faulty gene is replaced or supplanted. In others . . . Gene expression is blocked to silence a harmful gene (and for research, gene knockout, studies of function) with, e.g. . . . Antisense RNAs.
Here’s some animations from McGraw-Hill that I encourage you to check out.

http://www.bio.fsu.edu/~stevet/VSU/animations/Chapter12/restriction_endonucleases.swf

http://www.bio.fsu.edu/~stevet/VSU/animations/Chapter12/genetic_engineering.swf

http://www.bio.fsu.edu/~stevet/VSU/animations/Chapter12/steps_in_cloning_a_gene.swf

http://www.bio.fsu.edu/~stevet/VSU/animations/Chapter12/transfer_of_gene_toPlasmid.swf

But we won’t take the time now.
And now a video; a real easy one first!

http://www.youtube.com/watch?v=AEINuCL-5wc

Tuesday, April 17, 2012
And then some reminders before another video...

1. The last class meeting before the final will be very important. It will cover all topics that have been troublesome over the entire semester, as a review for the final. And there will be an in-class assignment. In fact, here it is: For that meeting, write down three questions from previous exams that you don’t understand.

2. You’ve still not gotten all your old exams! This is ridiculous. As I’ve repeatedly said over the entire semester – the final exam will be built directly off these old exams, and it’s worth 40% of the course lecture grade. That’s the difference between failing and passing, maybe even getting a decent grade (e.g. $20\%$ [full in-class credit] + $20\%$ [only $50\%$ on all section tests] + $40\%$ [100% on final] = 80%, a “B” for the lecture portion of the course, without any extra credit at all!).
The comprehensive final . . .

✓ Biol 1010-20585 (i.e. M/W at 10:00):
  Wednesday, April 25, at the usual class
time, and in the usual classroom.

✓ Biol 1010-20586 (i.e. T/Th at 12:00):
  Thursday, April 26, at the usual class
time, and in the usual classroom.

✓ And no taking it early, nor any makeups
either, period! If you have a conflict, you
are to take it up with the SGCEP Director.
Don’t forget . . .

The last class meeting before the final is the final In-Class assignment for the semester — bring your three questions — and it’s a VERY worthwhile preview for the final exam!
Now the more complicated video. Do pay attention – at least one question on the final will be from it!

http://www.learner.org/courses/biology/units/gmo/