7-minute science
Questions
One day, a mutation...

ACG\text{GTGCATA}  
ACG\text{GTACATA}
...caused neoteny...
...which was good news and bad news. We are smarter.
...but we are basically helpless for our first years of life.
Babies can't go on hunts

They scare the prey.
...and you can't leave them home alone...

...so mom stays home.
Baby and mother need to eat, requiring a provider...
...requiring "rewards" for the provider.
...made more effective by mutual rewards
...leading to more sexual activity, thus more babies...
...leading to starvation...
...leading to...

...birth control.
Early methods of birth control

- Taboos, abstinence
- Herbs
- Infanticide
- Rituals
Modern Methods:

Barrier methods

- Requires planning ahead.
- Last minute application.
- May fail.

<table>
<thead>
<tr>
<th>Barrier Methods</th>
<th>Male Condom</th>
<th>Female Condom</th>
<th>Spermicide</th>
<th>Diaphragm</th>
<th>Cervical Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="#">Male Condom</a></td>
<td><strong>What is it?</strong> A thin covering that you unroll over the hard penis. Made of</td>
<td><a href="#">Female Condom</a></td>
<td><strong>What is it?</strong> Spermicidal chemical comes in several forms; you can choose</td>
<td><a href="#">Diaphragm</a></td>
<td><a href="#">Cervical Cap</a></td>
</tr>
<tr>
<td><a href="#">compare</a></td>
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<td><a href="#">read more</a></td>
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</tbody>
</table>
### Knowledge Based Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>What is it?</th>
<th>Action or Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Withdrawal (Pulling Out)</strong></td>
<td><em>What is it?</em> The man takes his penis out of his partner’s vagina before</td>
<td><a href="#">read more</a></td>
</tr>
<tr>
<td><strong>Fertility Awareness</strong></td>
<td><em>What is it?</em> When you understand your fertile time (days you can get</td>
<td><a href="#">read more</a></td>
</tr>
<tr>
<td><strong>Breastfeeding (Lactation Amenorrhea)</strong></td>
<td><em>What is it?</em> Breastfeeding stops egg development if the following three</td>
<td><a href="#">read more</a></td>
</tr>
<tr>
<td><strong>Sex Without Intercourse</strong></td>
<td><em>What is it?</em> You can experience intimacy, closeness, pleasure and orgasms</td>
<td><a href="#">read more</a></td>
</tr>
</tbody>
</table>

Knowledge-based

- Always available.
- Free.
- Not fool-proof.
### Long Term Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implant</strong></td>
<td><em>What is it?</em> A soft rod 1½ inches long that is placed under the skin in.</td>
</tr>
<tr>
<td><strong>IUD Progesterone</strong></td>
<td><em>What is it?</em> Intra-Uterine Device shaped like a small plastic T with a</td>
</tr>
<tr>
<td><strong>IUD Copper</strong></td>
<td><em>What is it?</em> Intra-Uterine Device shaped like a small plastic T wrapped in</td>
</tr>
<tr>
<td><strong>Sterilization</strong></td>
<td><em>What is it?</em> For Females, the fallopian tubes are blocked or cut, either</td>
</tr>
</tbody>
</table>

- Not free.
- Almost fool-proof.
- No actions needed.
<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Contraception</td>
<td>A pill or combination of pills you take after sex to prevent</td>
</tr>
<tr>
<td>The Pill</td>
<td>A pill containing synthetic hormones you take orally every day</td>
</tr>
<tr>
<td>The Patch</td>
<td>A bandage-like patch that sticks to your skin. Hormones are</td>
</tr>
<tr>
<td>Vaginal Ring</td>
<td>A clear, soft, flexible 2-inch circle worn in vagina. Your</td>
</tr>
<tr>
<td>The Shot</td>
<td>A long-acting injection of synthetic progestin hormone.</td>
</tr>
</tbody>
</table>

Hormonal

- Not free.
- Not fool proof.
- Side effects.
- Very effective.
Birth control implant
Also called: Contraceptive implant

Availability
Clinic visit needed

Effectiveness
Over 99% effective

Effort
Lasts up to 4 years

Overview
The implant is a very small rod inserted under the skin of a woman's upper arm to provide birth control. It's invisible and prevents pregnancy for up to 4 years.

Common brand: Nexplanon
Family Planning Needs Increasingly Met by Modern Methods, but More Progress Needed

Percent of Demand for Family Planning Satisfied by Modern Contraceptive Methods

EGYPT 64 80
JORDAN 41 58
KENYA 40 52
PHILIPPINES 36 47
PAKISTAN 21 43
NIGERIA 13 31
Sénégal 13 80

NOTE: Data points are for each corresponding survey year.
SOURCE: ICF International, Demographic and Health Surveys.
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Steady Drop

The U.S. abortion rate has declined significantly in recent years.

Abortions per 1,000 women aged 15–44

2008: 19.4
2011: 16.9 (13% decline)
2014: 14.6 (14% decline)

Source: Guttmacher Institute.

www.guttmacher.org
Pregnancies by Intention Status

Nearly half of U.S. pregnancies are unintended.

- Intended: 55%
- Mistimed: 27%
- Unwanted: 18%

www.guttmacher.org
Can replacement value could be attained by informed consent + perfect adherence?

- 213 million pregnancies occurred in 2012
  - 85 million pregnancies, representing 40 percent of all pregnancies, were unintended (mistimed or unwanted).
    - Of these, 50% ended in abortion,
    - 13% ended in miscarriage, and
    - 38% resulted in an unplanned birth. (=32.3M)
  - 128 million pregnancies were intended.
    - Of these, 84% resulted in planned birth (=108M)
- Total births in 2012 was 140 million.
- Total deaths in 2012 was 56 million.
- Natural Increase = 84 million (= 1.2% growth rate)
- Hypothetical natural increase without unplanned births = 52 million.

Informed consent + perfect adherence could decrease growth rate from 1.2% to 0.7%


Imperfect adherence

Annual medical costs of UP in the United States were estimated to be $4.6 billion, and 53% of these were attributed to imperfect contraceptive adherence. If 10% of women aged 20–29 years switched from oral contraception to LARC, total costs would be reduced by $288 million per year.

Imperfect contraceptive adherence leads to substantial UP and high, avoidable costs. Improved uptake of LARC may generate health care cost savings by reducing contraceptive non-adherence.

"We found no evidence to indicate that existing interventions to reduce repeat teenage pregnancy were effective"
Estimated number of unintended (unwanted) children = ~32 million/year

Total global population growth = ~84 million/year

Eliminating unwanted births would cut population growth by 38%!

Decreased teen pregnancy means quality of life for young women would be improved due to increased education.
Q:

How is having a child like buying a refrigerator?
Some economists write about childbearing as though couples sat at the dining room table and worked out their mutual interest in having babies the way they might plan their investments or select a new refrigerator. Baby making is nothing like buying a refrigerator, however; it’s more like the appliance retailer bringing you a new refrigerator every year or two unless you’ve taken effective and consistent steps on a nearly daily basis to make sure none is delivered. Sexual intercourse is an act of intimate shared pleasure that occurs “many hundreds or even thousands of times more frequently than is needed to achieve the desired number of pregnancies,” as University of California population and health specialist Martha Campbell and colleagues have written. Rather than akin to ordering a refrigerator, more often the act includes steps—if nothing more than a prayer—to keep the delivery truck away from the door.
The "Johnny Anti-Appleseed Solution" for Overpopulation

"First...bless everyone with infertility.
1. Design a molecule that could bind DNA and make people sterile.
2. Design another molecule that would unmask the first and make the person fertile, just for a short time.
3. Make people work for the second pill*.
You'd get responsible parenthood. No more unwanted children, no juvenile delinquents... "

*Married couples only?

Can we make family planning more like "buying a refrigerator"?

Eric Pianka, Denton A. Cooley Centennial Professor of Zoology, UT Austin.

Author of *The Vanishing Book of Life on Earth*
walking it back...

The Requirement of Informed Consent

<table>
<thead>
<tr>
<th></th>
<th>informed</th>
<th>not informed</th>
</tr>
</thead>
<tbody>
<tr>
<td>consentual</td>
<td>ok</td>
<td>coerced</td>
</tr>
<tr>
<td>not consentual</td>
<td>forced</td>
<td>covert</td>
</tr>
</tbody>
</table>

- What would happen if contraception/sterilization was administered without **informed consent**? (just think a minute)
- Examples:
  - Birth control in the drinking water.
  - Live, engineered, contagious, contraceptive virus.
India's state of emergency between 1975 and 1977 included a family planning initiative that began in April 1976 through which the government hoped to lower India's ever increasing population. This program used propaganda and monetary incentives to [deceive and coerce] citizens to get sterilized. People who agreed to get sterilized would receive land, housing, and money or loans.

A strong backlash against any initiative associated with family planning followed the highly controversial program, which continues into the 21st century.[27]

Indira Ghandi

https://en.wikipedia.org/wiki/Compulsory_sterilization#India
Immune-based contraception?

Vaccination Targets

- **Gametogenesis** - testes or ovary proteins. Immune castration/spaying.

- **Fertilization** - Sperm proteins, egg proteins, signaling proteins

- **Implantation** - immuno-abortifactants

Safer.
Cheaper.
Reversible.
No action required.
sperm

CatSper

small piece of CatSper

immunity

vaccine
fixed mouse sperm + anti-CatSper 4 (green), DAPI nuclear stain (blue)
Figure 6. Inhibition of motility and fertility by CatSper antibodies against extracellular epitopes of CatSper 1(a3a4) and epsilon (CSε). (A) Motility analysis of capacitated mouse sperm in the Presence of 20 ug/ml antibodies by CASA. (B) In vitro fertilization performed with COC eggs. Antibodies are treated either during sperm capacitation or fertilization at 20 ug/ml (unpublished).
Other contraceptive vaccines that block fertilization

- Whole sperm
- Zona pellucida (ZP3) -- blocks egg/sperm reaction, causes degradation!
- Eppin -- blocks late sperm maturation step.
- YLP12 -- ZP mimic peptide
CatSper Project MacArthur Team Members (proposal not funded)

Christopher Bystroff, Ph.D. Rensselaer Polytechnic Institute
Jean-Ju Chung, Ph.D. Yale University School of Medicine
Robert Wyman, Ph.D. Yale University
Chunyu Wang, M.D. Rensselaer Polytechnic Institute
Scott Forth, Ph.D., Rensselaer Polytechnic Institute

Aileen Gariepy, M.D., M.Ph., FACOG. Yale University School of Medicine
Fred Sigworth, Ph.D. Yale University School of Medicine
Scott Michael, Ph.D. Florida Gulf Coast University
Sharon Isern, Ph.D. Florida Gulf Coast University
Rajesh Naz, Ph.D. West Virginia University School of Medicine
Jon Hennebold, Ph.D., Oregon Health and Sciences University
Clair Kaplan, M.S.N., APRN, Planned Parenthood of Southern New England
William Ryerson, Population Media Center

GM-099827
Research opportunities in overpopulation? Not much,...

Total number of posted grant opportunities listed on Grants.gov which include the word X anywhere in the full announcement.

<table>
<thead>
<tr>
<th>Word</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>cancer</td>
<td>158</td>
</tr>
<tr>
<td>alzheimer</td>
<td>55</td>
</tr>
<tr>
<td>poverty</td>
<td>25</td>
</tr>
<tr>
<td>population</td>
<td>383</td>
</tr>
<tr>
<td>contraception</td>
<td>3</td>
</tr>
<tr>
<td>overpopulation</td>
<td>0</td>
</tr>
</tbody>
</table>

Searches performed 4/17/2018
knee-jerk reactions

Tanzania allows 14 year old females to marry with parental permission, otherwise females can marry at 15. For males marriage age is 18. Notice anything peculiar here? Females do get pregnant from rape and incest too.

Like · Report

Chris Bystroff
58 mins ago

Someone should invent an immunocontraceptive!!

Like · Report

Vicky Donaldson
53 mins ago

Oh dear. Accidentally fed a troll.

Like · Report

Chris Bystroff
0 secs ago

No! A scientist. That is my research. Look me up. I am googleable. I... Read more

Like · Report

Write a reply...
Contraception taboo is alive and well

A US-based company aired a commercial for condoms in which a man is smiling and dancing after buying a large pack of condoms. Pakistan Electronic Media Regulatory Authority bans the commercial, calling it "an affront to Pakistani culture". 

good news nonetheless, but slow.

Pakistan TFR high compared to Iran, but dropping
good news nonetheless, but slow.
• Listen to the radio news, watch TV news, read newspaper, news blogs.

• Make notes of any **mention** of population.

• Make notes of **failure to mention** population when it is clearly relevant to the news story.

• Enter your result (with link if possible) in the *Ask* window (select Lecture 25)
Work on projects