INTRODUCTION TO HIV:
1. Equilibrium vs. Non-equilibrium Viruses
2. Structure of the retrovirus, HIV
3. Re-visit the “central dogma”
4. HIV life cycle
5. Infection statistics and health outcomes
Equilibrium and Non-Equilibrium Viruses

- Equilibrium viruses have been long term parasites of a given species
  - They are generally not lethal but spread well
  - The common cold is best example

- Non-equilibrium viruses have jumped from another species and are not adapted to the new host
  - They are sometimes very lethal, may spread poorly or well, and represent most of our difficult problem viruses

Examples of Equilibrium and Non-Equilibrium Human Viruses

<table>
<thead>
<tr>
<th>Equilibrium</th>
<th>Non-equilibrium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polio</td>
<td>Influenza (birds)</td>
</tr>
<tr>
<td>Smallpox</td>
<td>HIV (chimp)</td>
</tr>
<tr>
<td>Common cold</td>
<td>SARS (bats?)</td>
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<tr>
<td>Measles</td>
<td>Ebola (bats)</td>
</tr>
<tr>
<td>Herpes</td>
<td>Hantavirus (rodent)</td>
</tr>
</tbody>
</table>
CENTRAL DOGMA of MOLECULAR BIOLOGY

DNA → RNA → Protein
Replication Transcription Translation

UPDATED CENTRAL DOGMA - 1970

REVERSE TRANSCRIPTION by the enzyme, reverse transcriptase

DNA → RNA → Protein
Replication Transcription Translation

Modified from www.ascb.org
The Awful Statistics, 2005

- 65 million people have been infected, 25 million dead and 40 million living with AIDS (5 million in India; 0.8 million in China)
- 13,000 infections/day; 4.9 million/year
- 3.1 million dying per year— as much as tuberculosis or malaria
- Life expectancy in numerous African countries reduced by >20 years

Why is HIV Lethal?

- HIV is a classic non-equilibrium virus
- It is actually endemic in African great apes (chimpanzees) and got a foothold in the human population around 70 years ago

Why is HIV Lethal?

- It grows in one of the key cell types of our immune systems, the helper T cell, and kills them
- Infected people lose their helper T cells slowly, over years, ultimately become immunodeficient and die from infections by organisms that healthy people easily fight off

www.ascb.org
Part 2: “Why Gene Therapy Might be a Reasonable Tool for Attacking HIV”

by Dr. David Baltimore

www.ascb.org (iBioseminar series)
• **News in Brief**
• *Nature 449*, 390 (27 September 2007) | doi:10.1038/449390c; Published online 26 September 2007

**HIV vaccine failure prompts Merck to halt trial**

An HIV vaccine being developed by Merck has apparently failed, causing the company to halt a large and once-promising clinical trial last week.

Merck's STEP vaccine used a mixture of components from three weakened adenoviruses to carry three synthetically produced HIV genes. The hope was that each gene would stimulate an immune response against the virus, as earlier trials had suggested.

The latest trial began in 2004 and enrolled 3,000 people considered to be at high risk of infection. But a group of 741 volunteers who received the vaccine saw 24 HIV infections, compared with the control group of 762 people who saw 21 infections. Furthermore, the vaccine did not reduce the amount of HIV in the bloodstream of those infected.