The Future of Open Source: From Drug Discovery to Synthetic Biology
Why Open Source Matters

The “Open Source Biology” Idea
Analogy, Rhetoric, Reality
Synaptic Leap: How Big is the Landscape?
A Rational Design Approach

1. Background
   Definitions
   Showstoppers
   OS Theory: Incentives & Social Welfare
   The Drug Discovery Landscape

2. Candidates

3. Synthetic Biology

4. A (Quick) Word About Licenses

5. Synaptic Leap - A Short Infomercial
Definition:

Goal-Oriented Collaboration + Donated Labor & Materials
1. Background: Showstoppers

The Usual Suspects:

Developing Drugs is Costly
Drug Discovery is a Pipeline

Competition With Patent Incentives
A Neglected Disease Niche?
Companies Might *Fund* Open Source
1. Background: OS Theory

I. Incentives

A. Ideology

B. Education and Signaling

C. Own-Use
   - For Hobbies
   - For Work
   - For Employer

D. Complementary Goods & Services

E. Standards Wars
1. Background: OS Theory

Social Welfare

Advantages
- (Donated Labor)
- Price of Information
- Agency Problems/Transparency

Disadvantages
- Inadequate Incentives?
1. Background:
   The Drug Discovery Landscape

Basic Research
Finding Targets
Optimizing Targets
Finding Lead Compounds
Optimizing Lead Compounds
Process Development
Pre-Clinical Testing
Phase I Tests
Phase II Tests
Phase III Tests
Approval
Manufacturing
Phase IV Tests
Marketing & Distribution
2. Candidates

Basic Research → Open Science
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Marketing & Distribution
2. Candidates: Open Science

Examples
  BioPERL
  HGP, SNP Consortium, HapMap, AfCS.

Traditional Academic Incentives
  Education, Signaling, Own-Use, Ideology.

Showstoppers?
  Physics Precedents
    Big Science (*cf.* FermiLab)
    Virtual Experiments (PDG, TOI)

Definitional Objection - Is It Open Source?
  HapMap License
2. Candidates

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\{ \text{In Silico Biology} \}
2. Candidates: *In Silico* Biology

Social Analogy
Biologists ~ Computer Scientists
**Incentives** ~ Education, Signaling & Ideology
A *Social* Experiment

Science Analogy
Doing Science With Databases
*In silico* biology ~ software debugging
A *Scientific* Experiment
Social Welfare

Donated Labor
Lower R&D Costs
The SNP Consortium Problem
Lower Manufacturing Costs
Transparency

2. Candidates: *In Silico* Biology
2. Candidates: *In Silico* Biology

Example: Tropical Disease Initiative

Mechanics

*On-Line Forums & Running Estimates*

*Philosopher Kings?*

*Bridging Institutions*
2. Candidates: *In Silico Biology*

Showstoppers

Competition With Patents

Are *in silico* methods good enough?

Would it Work for Rich Nation Diseases?
2. Candidates

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“Wet” Chemistry & Biology
2. Candidates: Wet Chemistry & Biology

The Reagents Problem
Big Science Grants
“Scrounging Strategies”
- TDI, Benkler
Low Cost, High Ingenuity Problems
- Mat Todd/Schistosomiasis Project

What are the Limits?
2. Candidates

Basic Research
Finding Targets
Optimizing Targets
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Manufacturing
Phase IV Tests
} Off Label Testing
Marketing & Distribution
2. Candidates: Off-Label Testing

Examples
- von Hippel Proposal

Incentives
- Ideology, Education & Signaling
- Costs are Already Paid For
- Competition With Patents?

Social Welfare
- Transparency
2. Candidates

Basic Research
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} Clinical Testing
2. Candidates: Clinical Testing

Examples
   (None)

Incentives
   Ideology, Education, Signaling,
   Complementary Goods
   Patents Would Support OS

Advantages
   Transparency
3. Synthetic Biology

From Garage Science to Standard Parts
Reading Tea Leaves
A Chance to Intervene

Incentives: Five Stories
Ideology, Education and Signaling,
Own-Use, Complementary Goods & Standards Wars
3. Synthetic Biology: Incentives

Story 1: Ideology, Education, Signaling, Own-Use

Story 2: Shared Costs
Analogy: “Operating Systems vs. Applications Programs”
3. Synthetic Biology: Incentives

Story 3: Shared Benefits
Analogy: Game Theory & Embedded Linux
Multiple Possible Equilibria
Prodding the System

Story 4: Appropriability May Not Be Valuable
Analogy: Software Modules & LINUX
Standards Wars?
Parts Repository – Strong Tipping Effects
Private vs. Public Repositories
An Unpredictable Process

3. Synthetic Biology: Incentives

Open Standards, Competition, Antitrust National Security?
4. License

“Copyright vs. Patents”

The Licensing Fetish

What’s Wrong With the Public Domain?

The Consumer Sovereignty Argument

The Capturing Argument

The Stability Argument
4. Licenses

GPL’ing Molecules

Patents vs. Copyright
  Filing & Enforcement Costs
  Licensing & Waiver Law Issues
  Patent Misuse?
  Patents & Neglected Diseases

Embargos

Legal Holding Entities

Patent Pools
  BIOS/Bioforge
5. Infomercial

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