Remote Biology Labs

Accessible and Ubiquitous Biology Technology

Austin Che

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Massachusetts Institute of Technology

E-ducation Without Borders

Abu Dhabi, UAE

The Coming Biology Age

Stone

Bronze

Iron

The Coming Biology Age

Stone

Bronze

Iron

Silicon

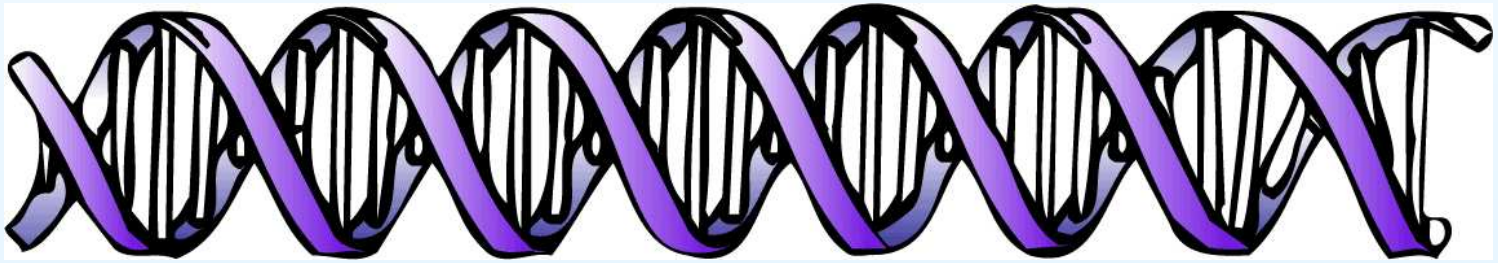
The Coming Biology Age

Stone

Bronze

Iron

Silicon



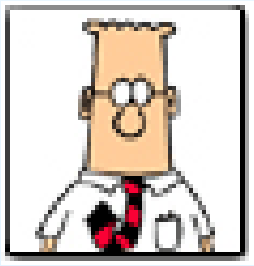
Carbon

The Transition from Science to Engineering

A Scientist discovers that which exists.

An Engineer creates that which never was.

-Theodore von Karman



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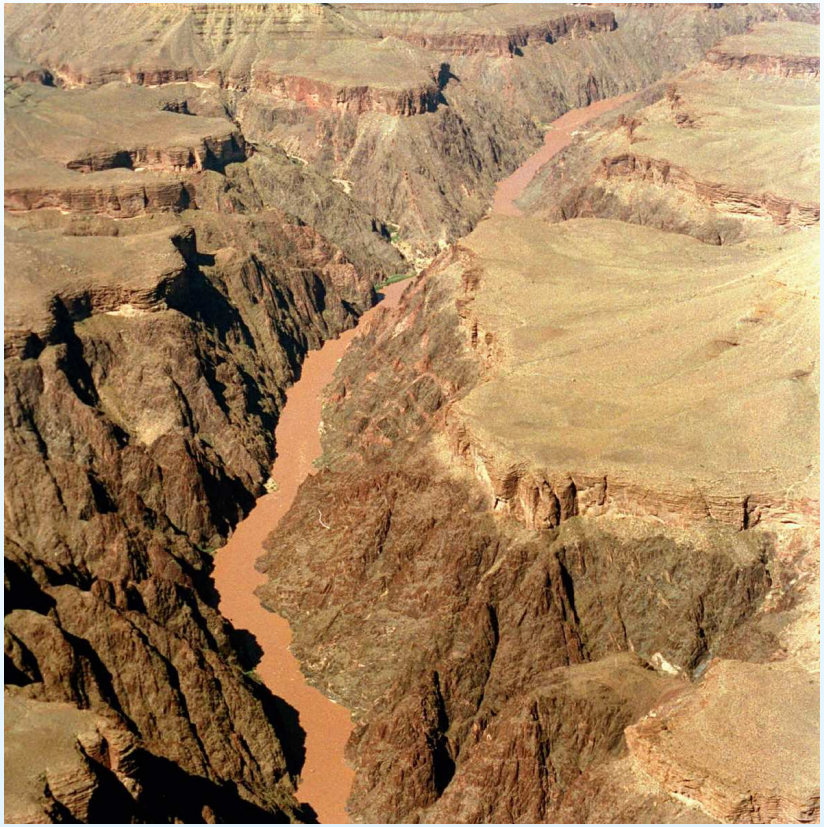
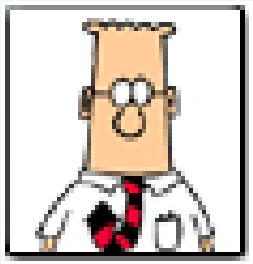
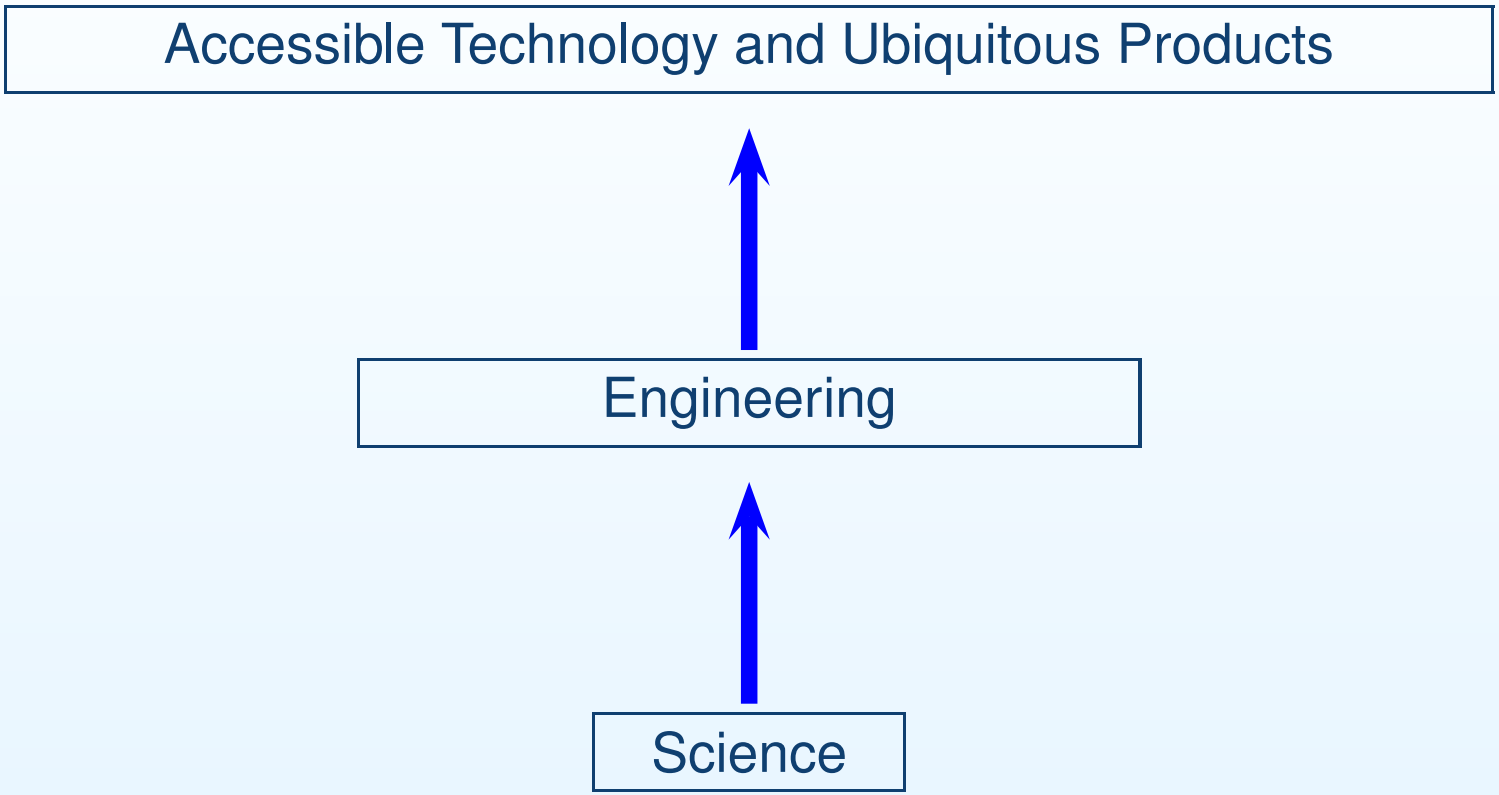




The Grand Canyon

The Emergence of Synthetic Biology



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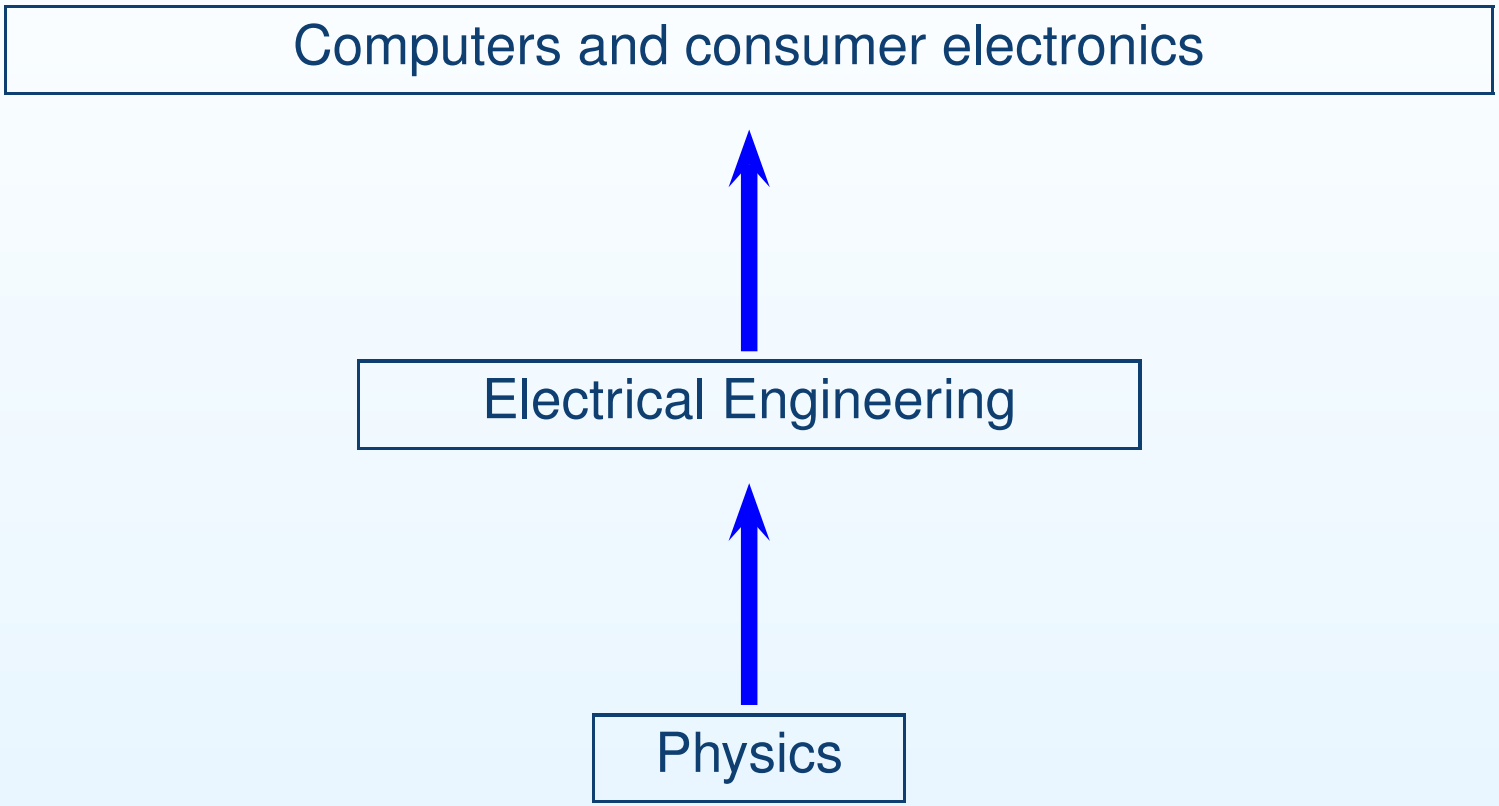

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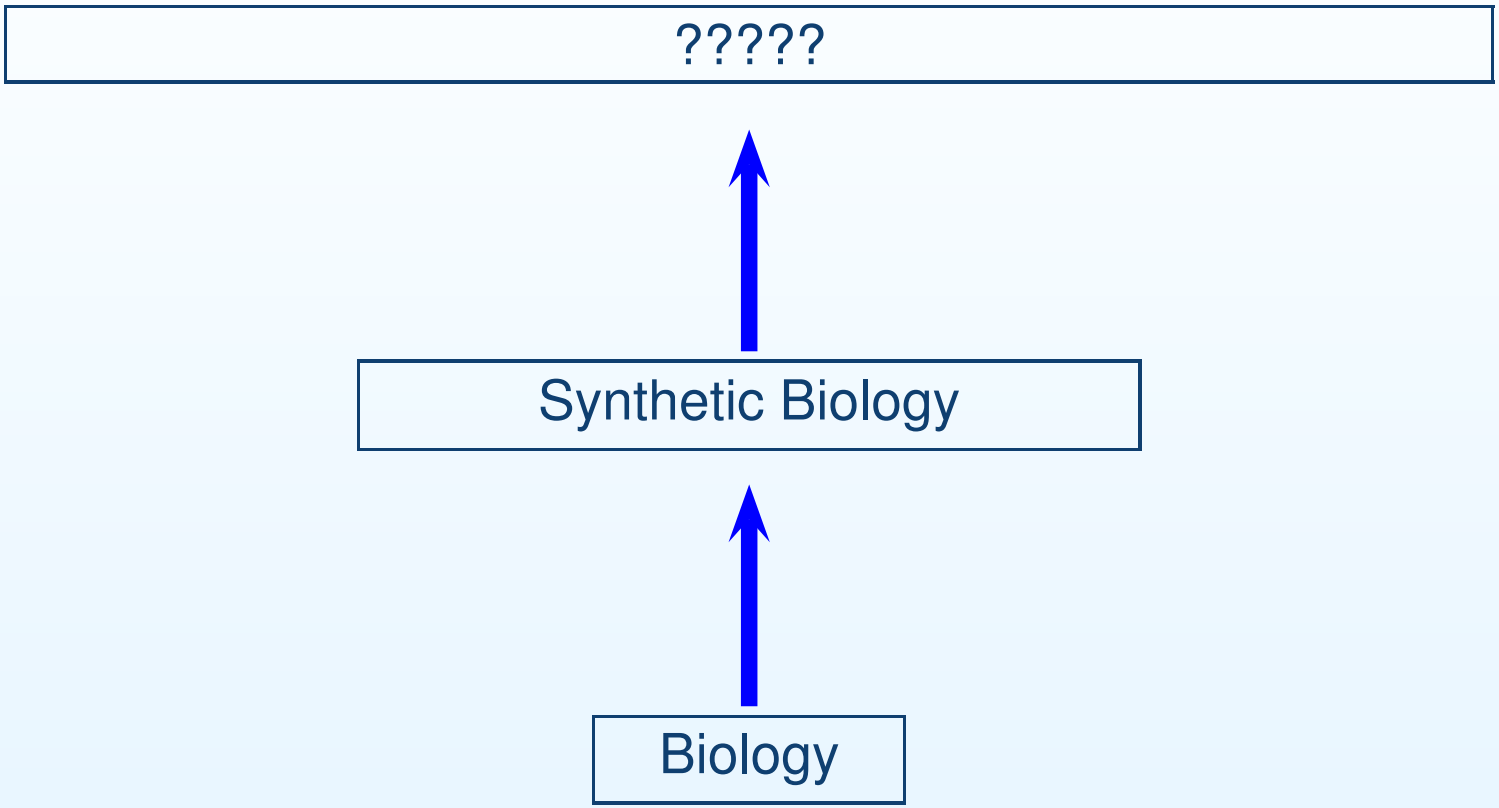
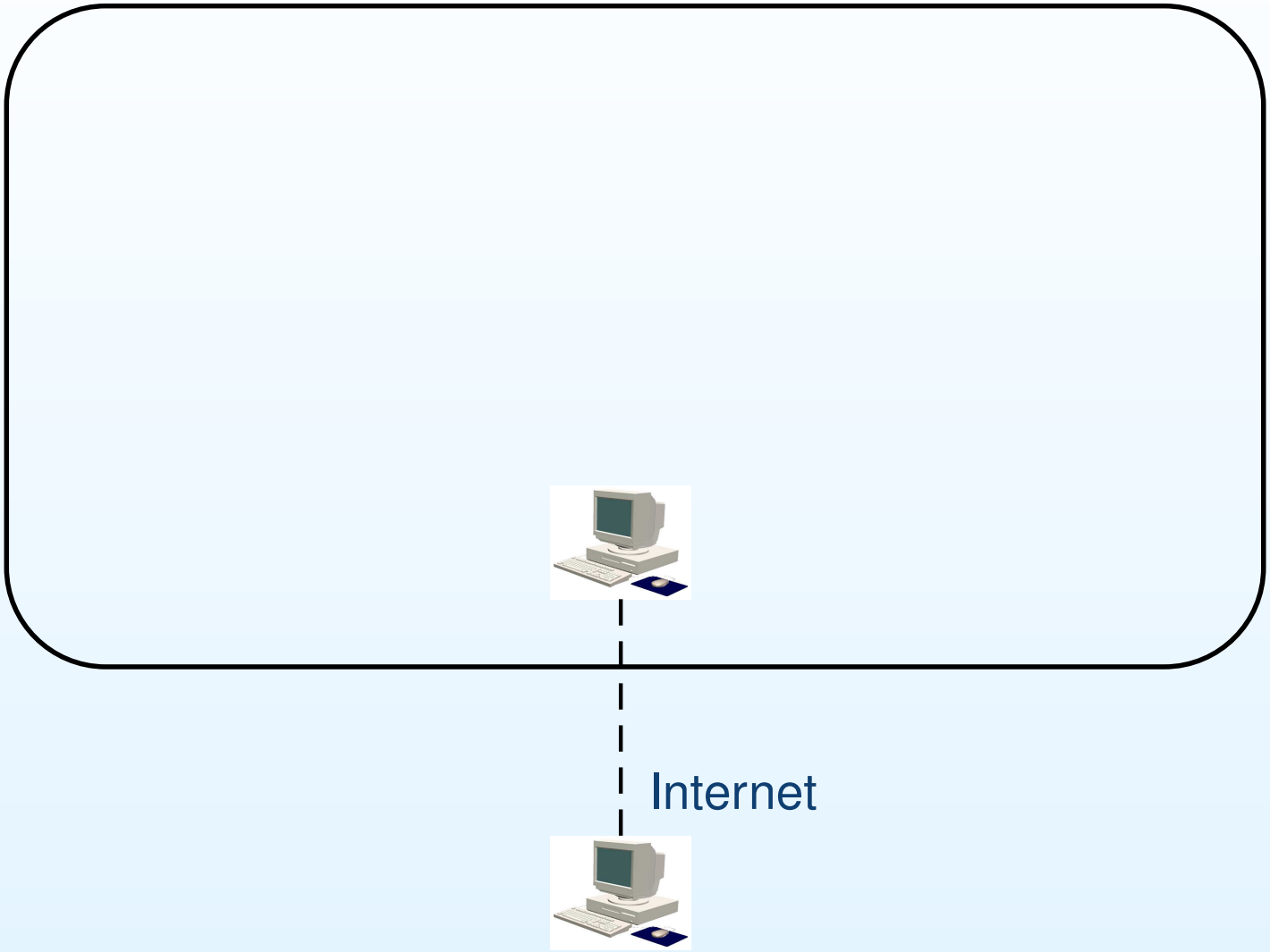


http://www.syntheticbiology.org/

Synthetic Biology: Design and build new biological parts, devices and integrated biological systems

Remotely Controlled Biology Labs



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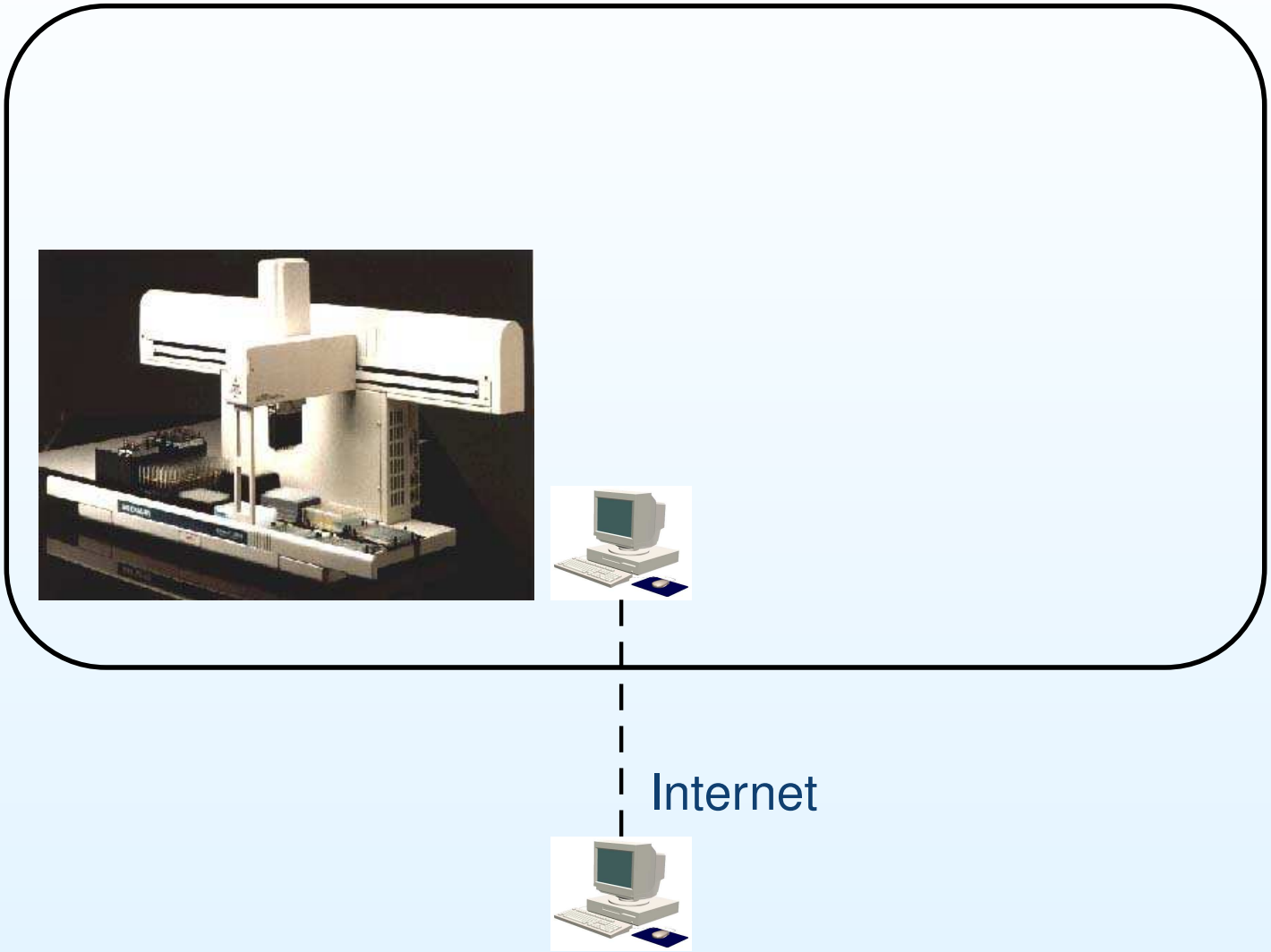

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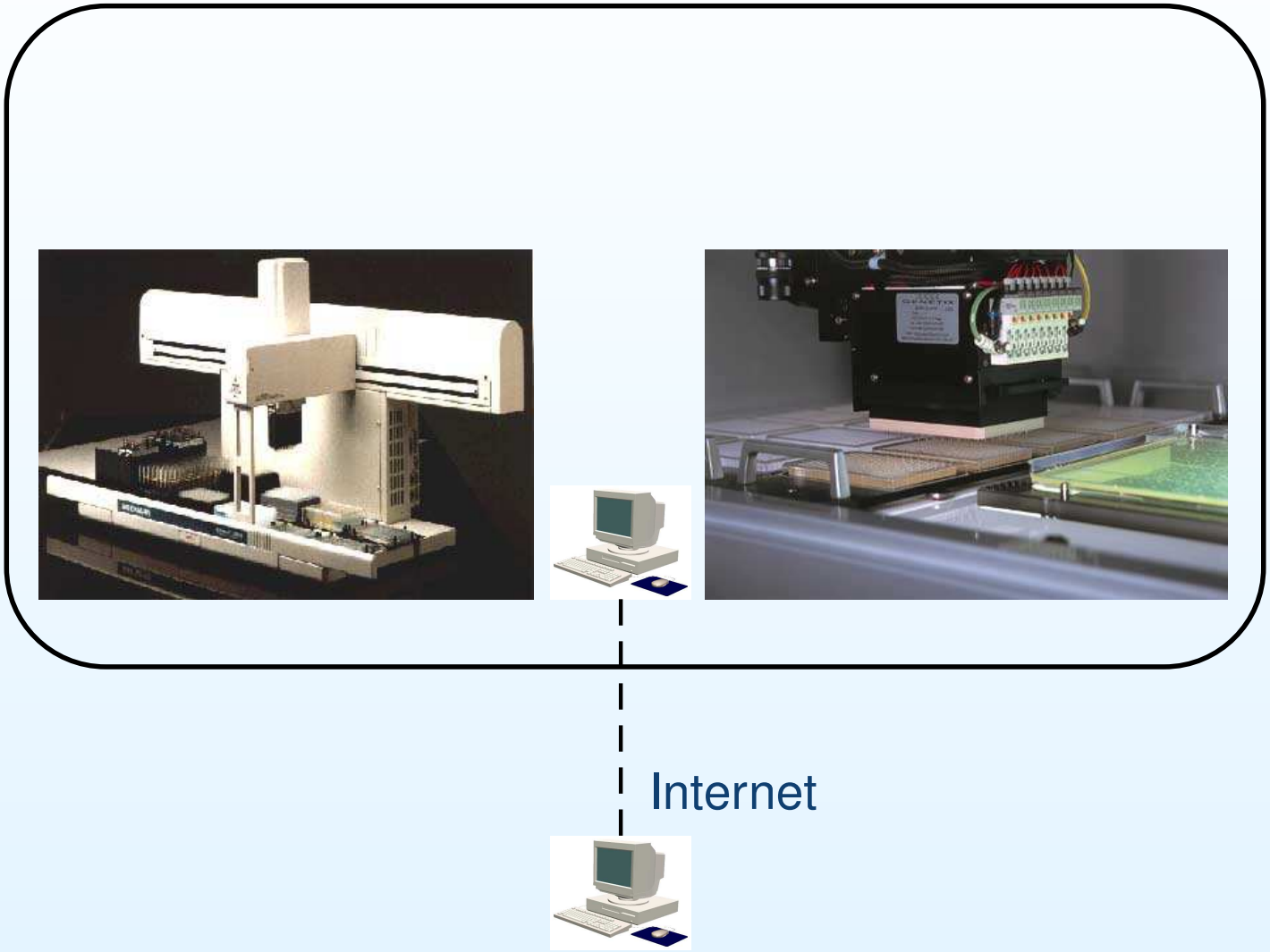

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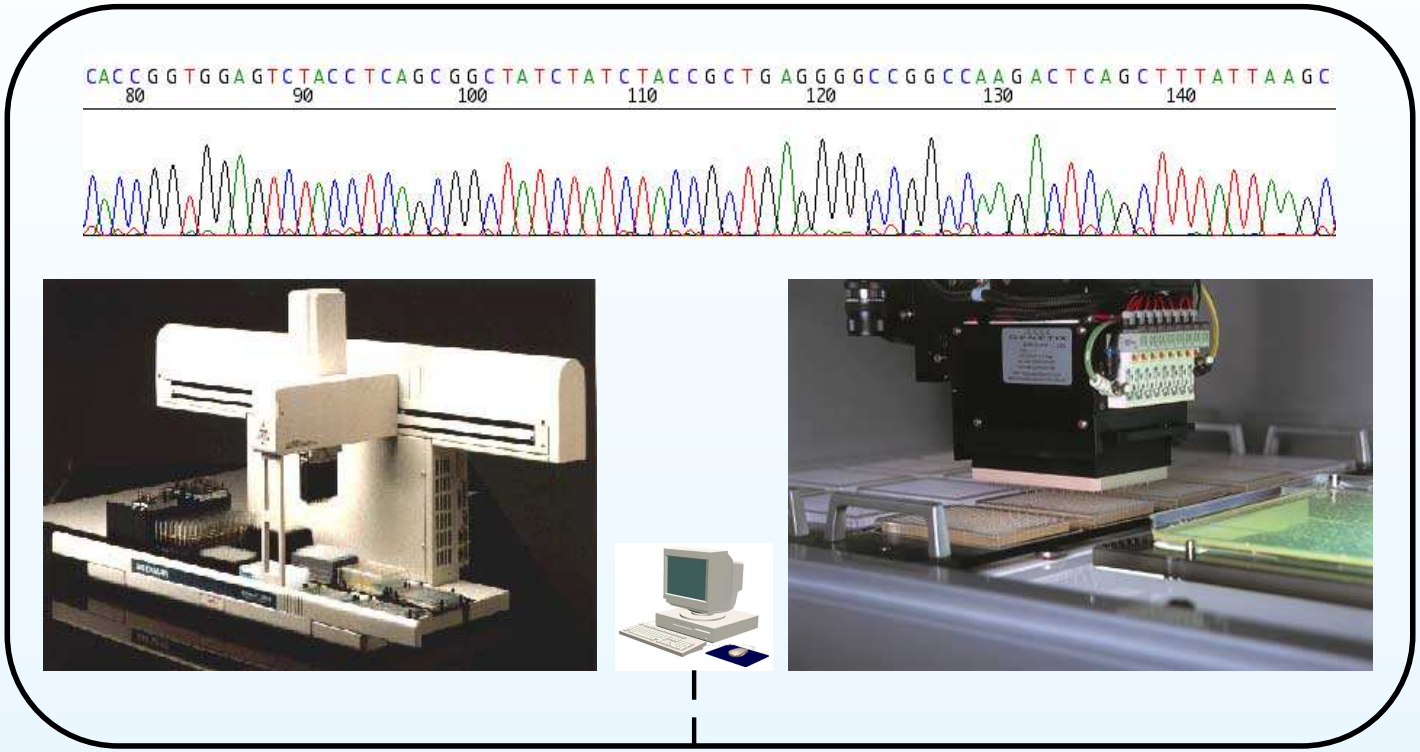

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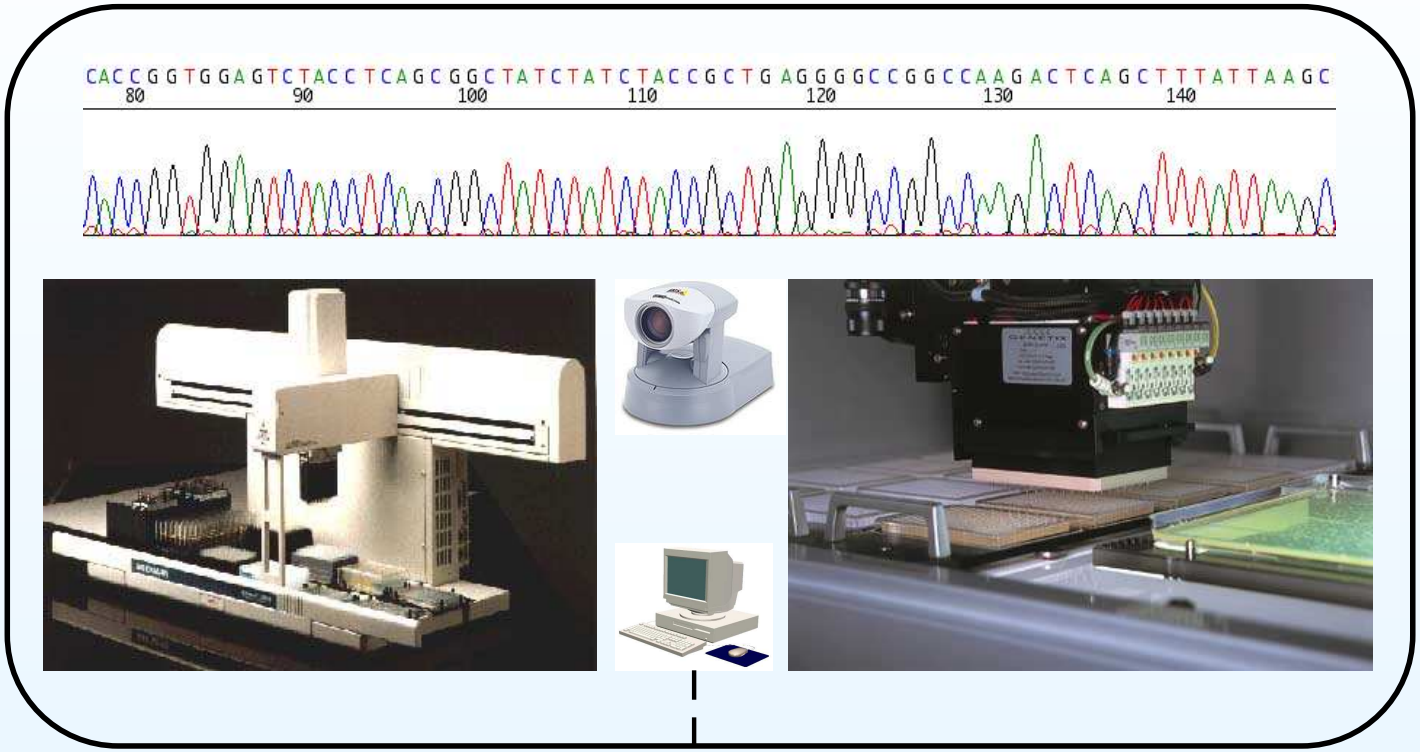

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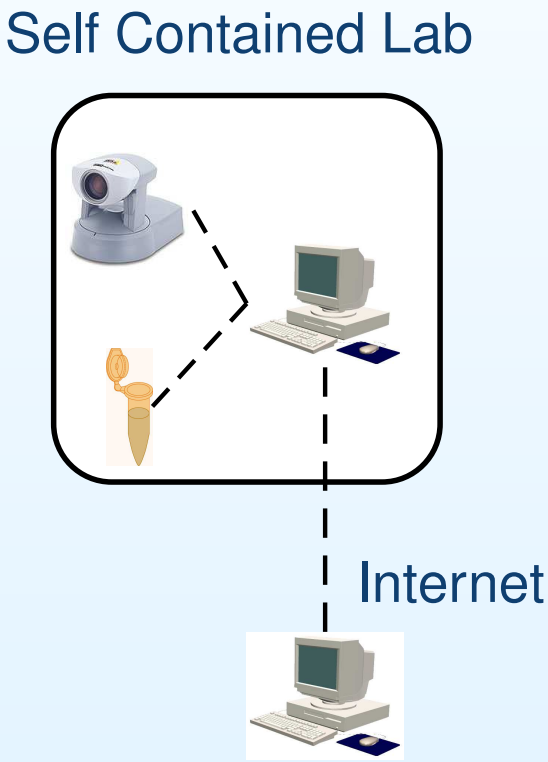
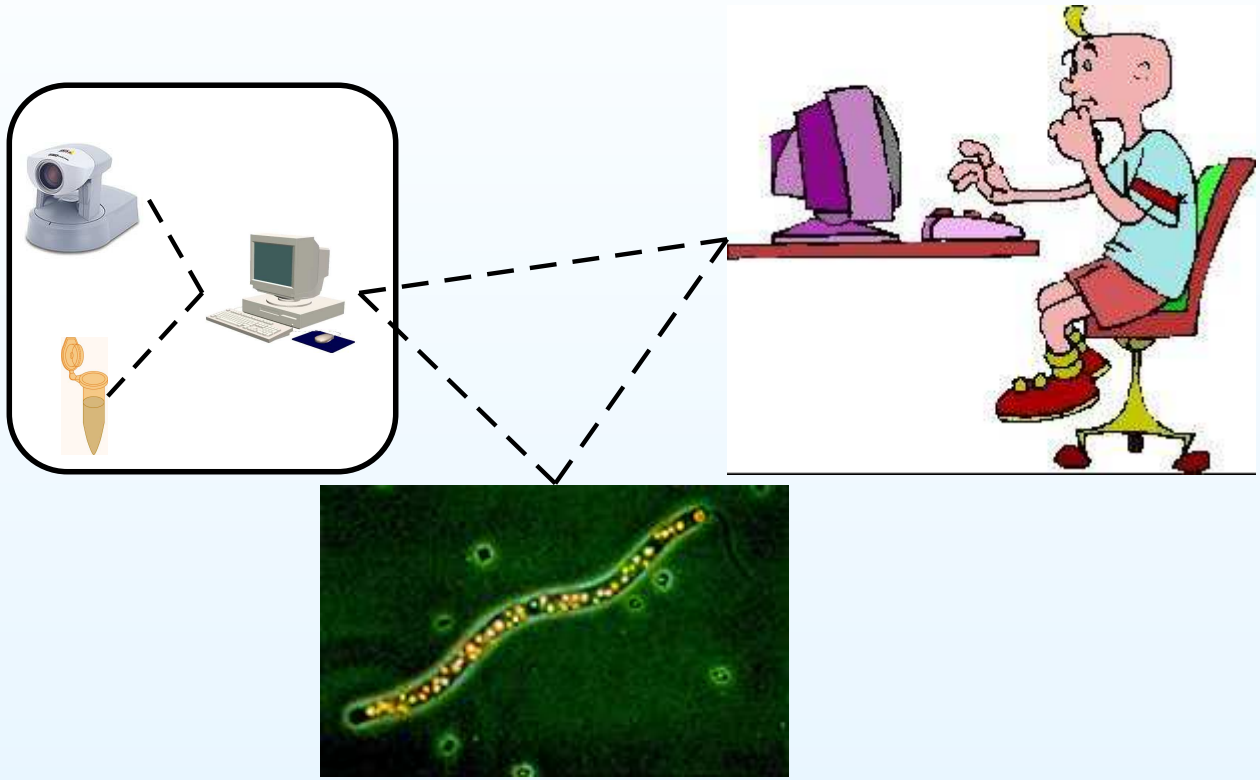
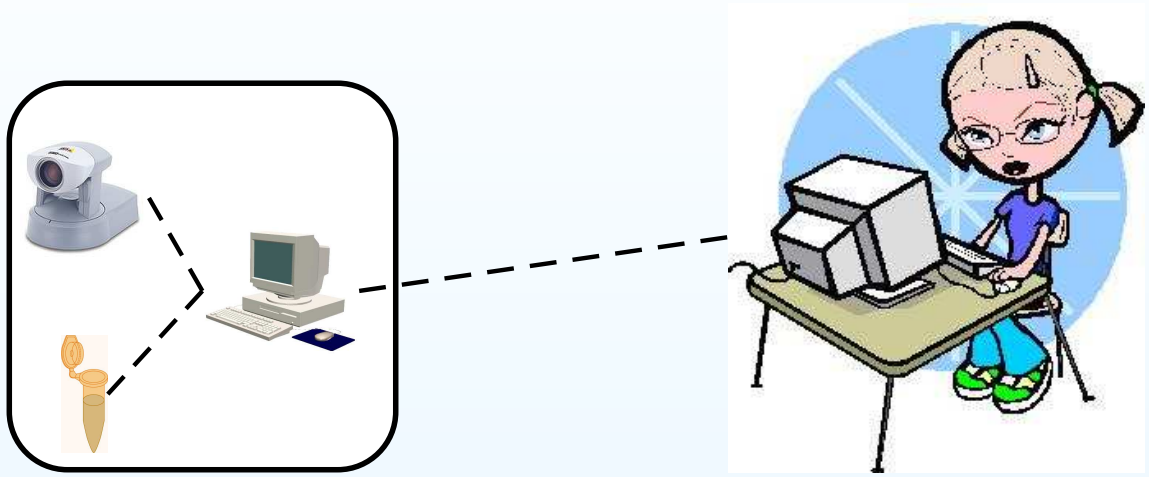


Training the Next Generation Biohackers



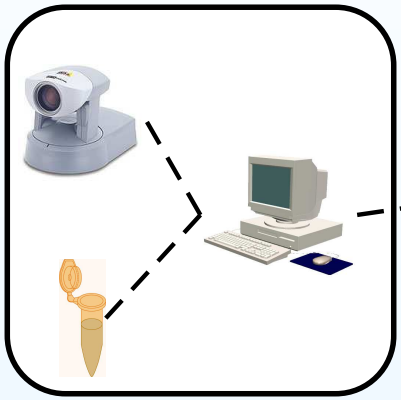
- Safe, inexpensive, and fun environment to learn
- Begin experimenting while young
- Many details are hidden

Classroom Lab Education



- Teacher specifies permissible operations
- Saves time and cost of lab supervision
- Focus on specific educational goals

Research Education



- Saves muscles from pipetting overdose
- Reduces time to learn and relearn lab protocols
- High degree of control (if desired)

Variable Human Control

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Creative insight

Hypothesis generation

Result analysis

Experiment design

Protocol selection

Equipment operation

Pipetting

Prepare materials

Lab maintainence

Waiting

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Robot Scientist

King, Ross D., et al. “Functional genomic hypothesis generation and experimentation by a robot scientist.” *Nature* 427 (Jan. 2004): 247–252. doi:10.1038/nature02236

Creative insight
Hypothesis generation
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Work Efficiency

If necessity is the mother of invention,
laziness is the father of invention.

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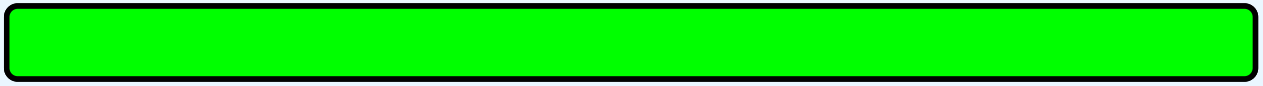
Efficiency: Being able to do useful work in the rare times I have energy and want to work. (Austin's)

Efficiency: 

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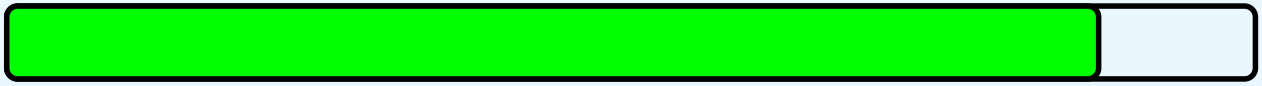
Efficiency: 

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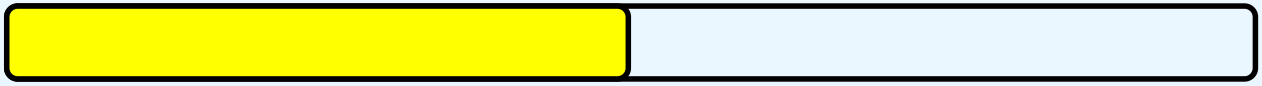
Efficiency: 

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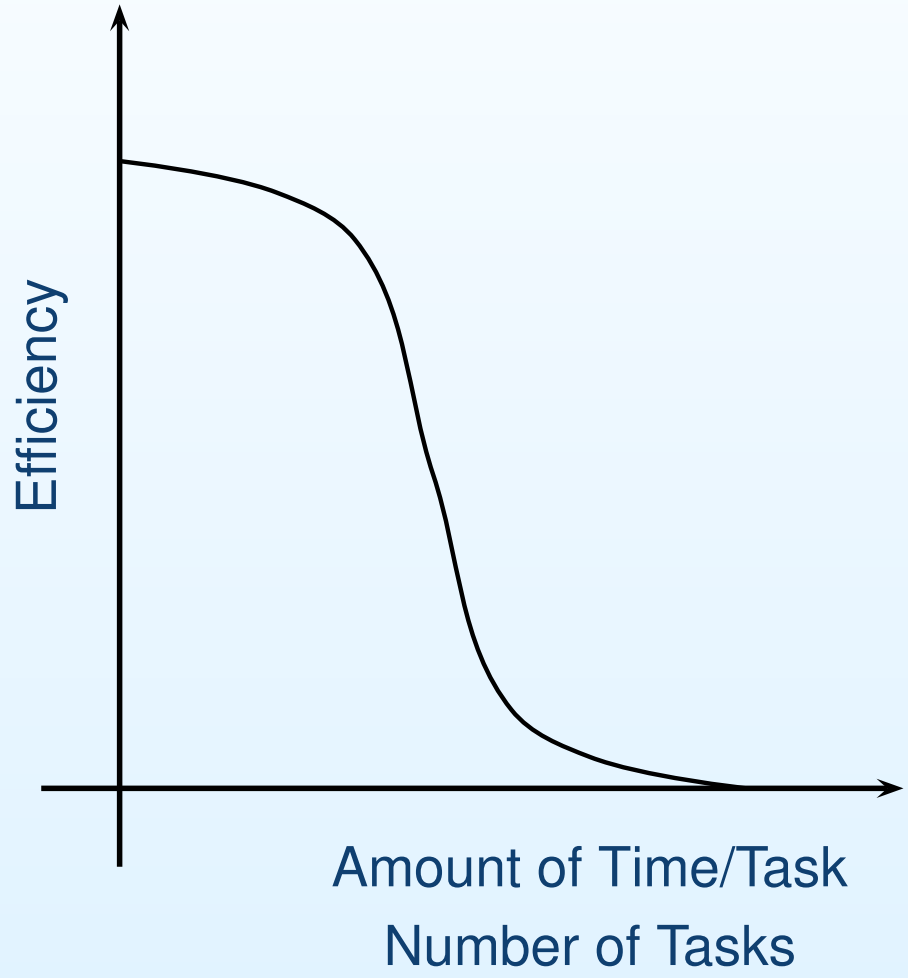
Efficiency: 

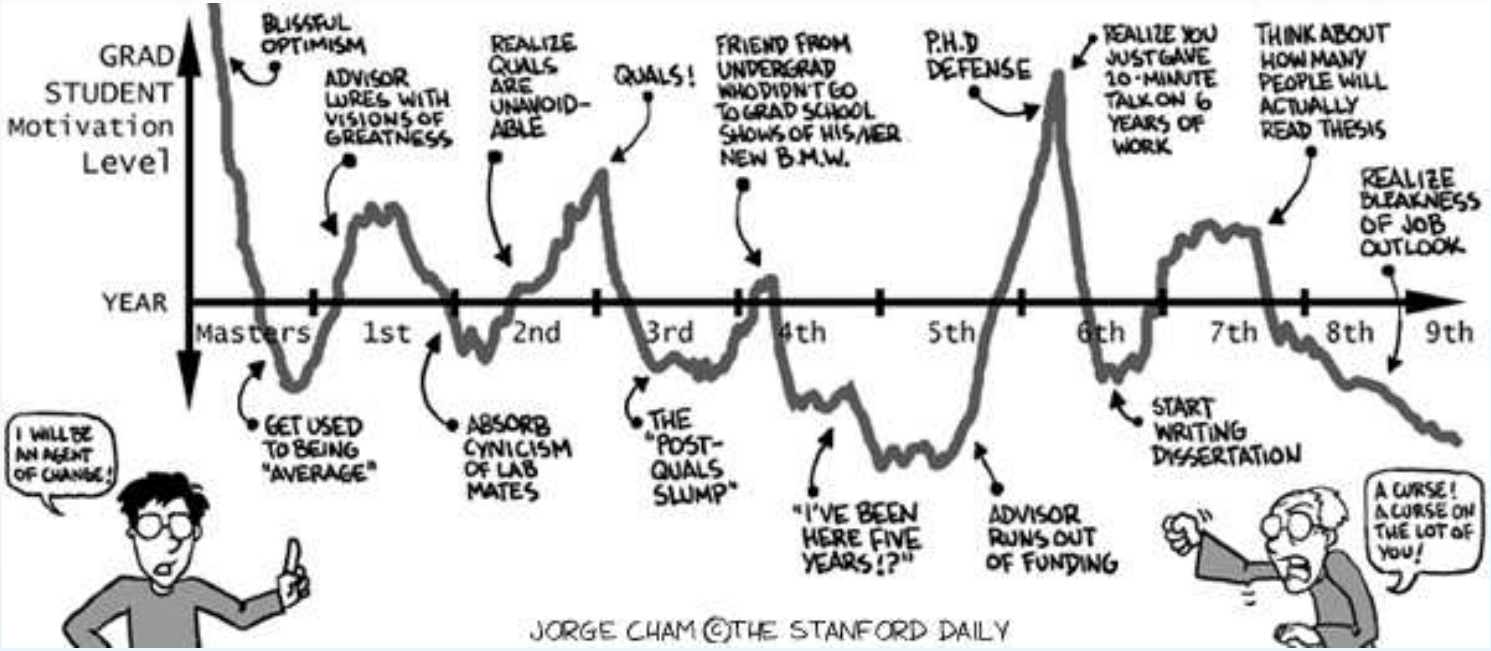
Work Time Fragmentation and Planning

⇒ *Work efficiency is inversely related to the average amount of time it takes to perform individual tasks and to the number of individual tasks.*



Work Time Timing

⇒ *Work motivation fluctuates and efficiency will be greatest when work can be done at the same time one has high motivation.*



(Piled Higher and Deeper)

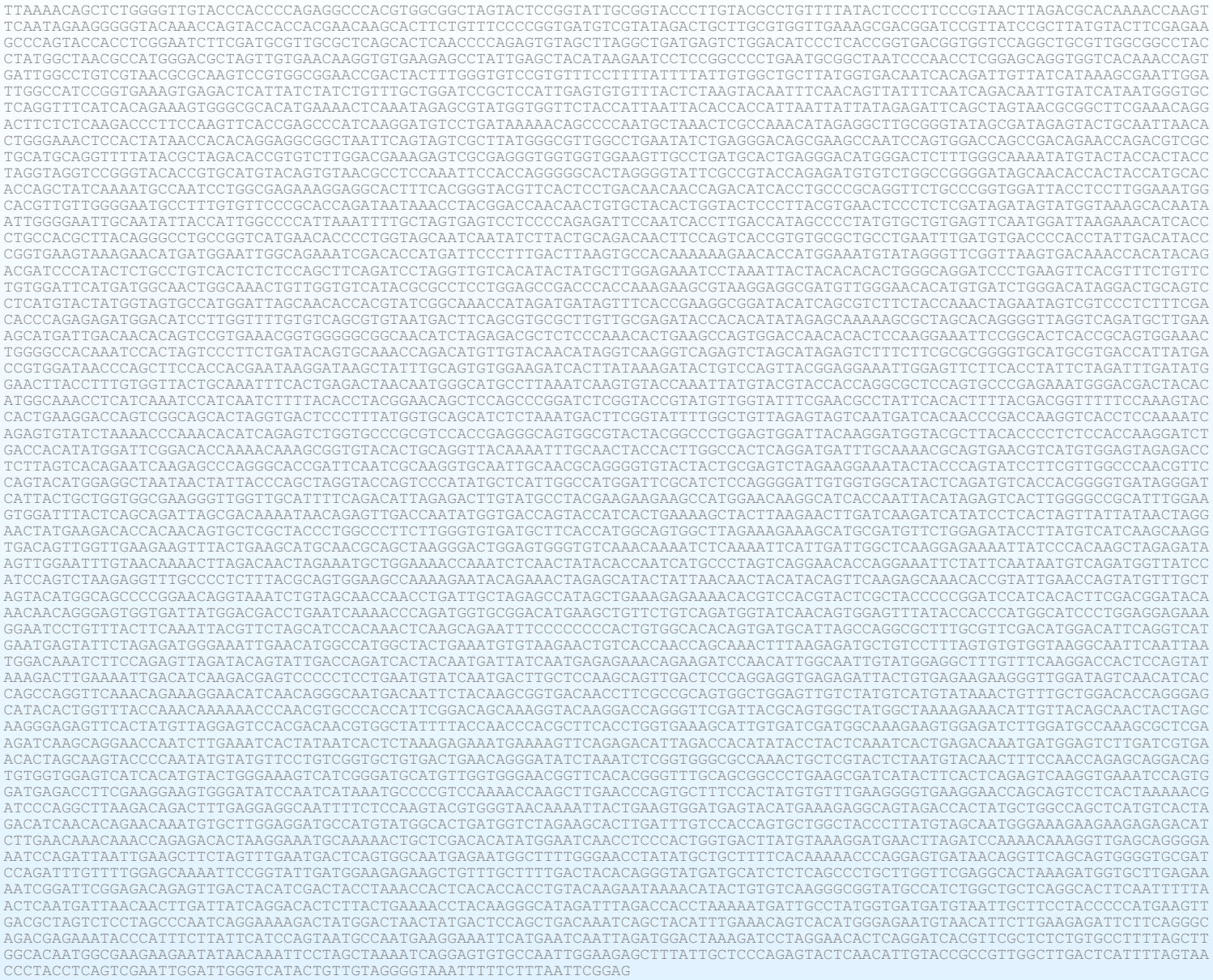
Ethics: Are we ready?

There is no great invention, from fire to flying, which has not been hailed as an insult to some god.

-J.B.S. Haldane, Daedalus, or Science and the Future (1923)

Alba, The GFP Bunny (Eduardo Kac)

Risk and Safety



Risk and Safety

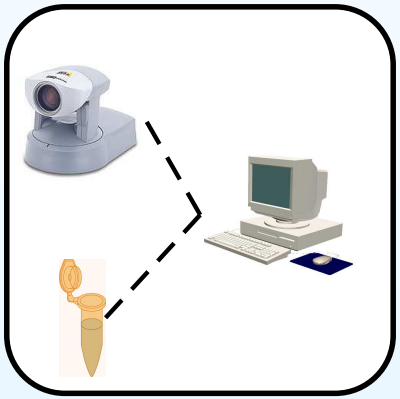
Conclusion

There is no reason anyone would want a computer in their home.

-Ken Olson, president, chairman, and founder of Digital Equipment Corp (1977)

There is no reason anyone wouldn't want a biomachine in their home.

-Austin Che (2005)



The transition from science to engineering is the key to ubiquitous biology technology.

Thanks!

Thanks to the e-ducation without borders organizing committee!