



Molecular Computing

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[Cliff Johnson](#)

[Areio Soltani](#)

[Rolfe Schmidt](#)

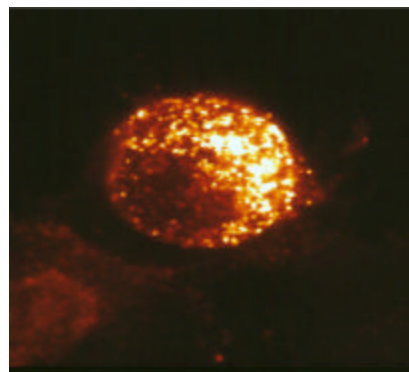
[Billal Shaw](#)

[Dustin Reischus](#)

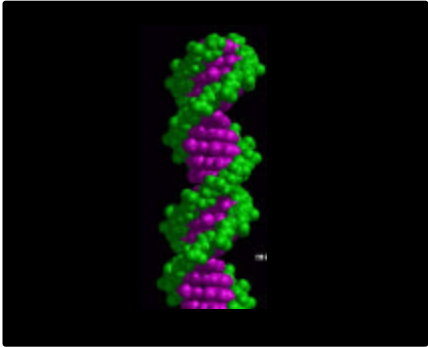
Defense Advanced Research Projects Agency
Office of Naval Research
JPL/NASA



[http://americanhistory .si.edu/ve/](http://americanhistory.si.edu/ve/)



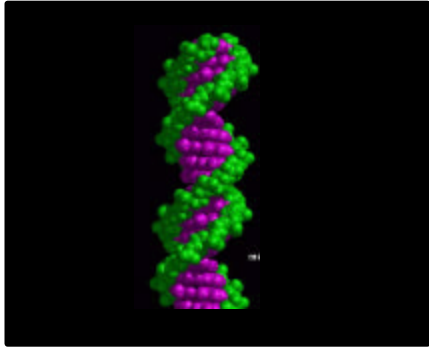
<http://www.nen.com>



DNA

<http://www.uwec.edu/academic/curri/scalesjb/images/DNA/dna%20collection.htm>


Extreme Information Density



DNA

<http://www.uwec.edu/academic/curri/scalesjb/images/DNA/dna%20collection.htm>

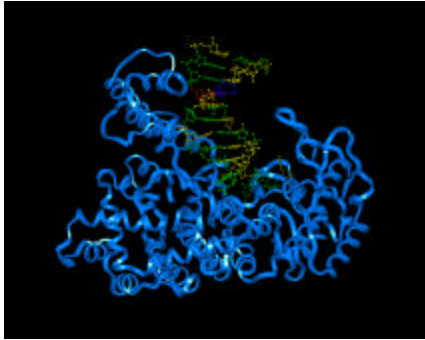
Extreme Information Density



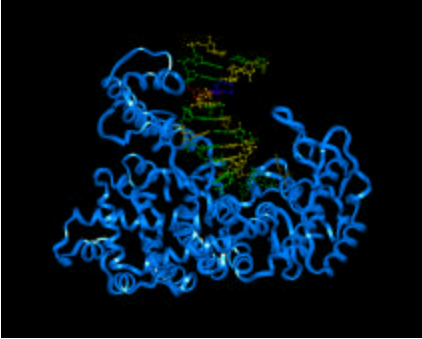
DNA

1 gram
4,000,000,000,000,000,000
bits


<http://www.uwec.edu/academic/curri/scalesjb/images/DNA/dna%20collection.htm>



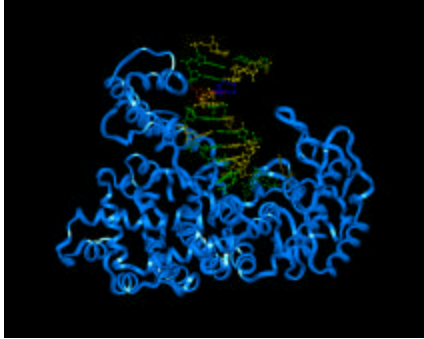
Polymerase



Polymerase

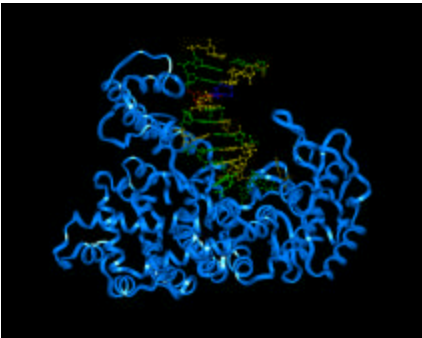


Extremely Small



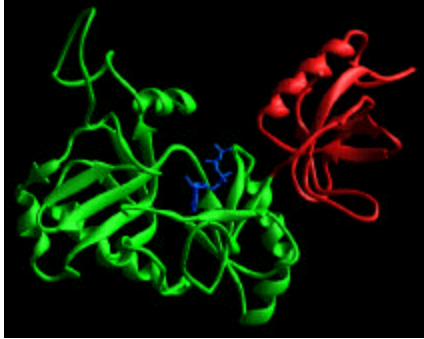
Polymerase

Extremely Small



Polymerase

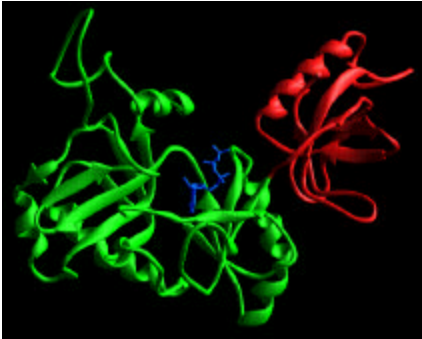
1ml
5,000,000,000,000,000,000
molecules



Ligase

<http://www.icnet.uk/labs/wigley/projects/ligase/lig1.htm>

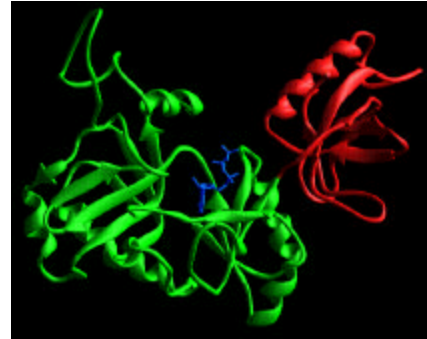
Extremely Energy
Efficient



Ligase

<http://www.icnet.uk/labs/wigley/projects/ligase/lig1.htm>

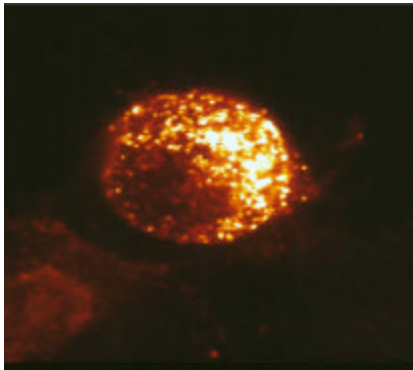
Extremely Energy
Efficient



Ligase

1 Joule
20,000,000,000,000,000
operations

<http://www.icnet.uk/labs/wigley/projects/ligase/lig1.htm>



<http://www.nen.com>

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The Theory of Computation



TURING



CHURCH



KLEENE



GÖDEL

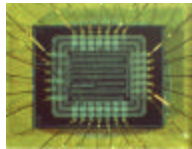
Computing is Easy

1. A METHOD FOR STORING
INFORMATION

2. A FEW SIMPLE OPERATIONS
FOR ACTING ON
INFORMATION

Computing is Easy

1. A METHOD FOR STORING
INFORMATION

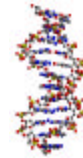


2. A FEW SIMPLE OPERATIONS
FOR ACTING ON
INFORMATION



Computing is Easy

1. A METHOD FOR STORING
INFORMATION



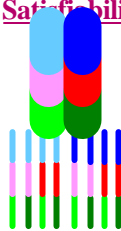
2. A FEW SIMPLE OPERATIONS
FOR ACTING ON
INFORMATION






1994 Experiment



Satisfiability



			
John	Y		N
Ted		N	Y
Sue	Y		Y

(B or -G) and (-R or G) and (B or G)

~~ATCCTA~~

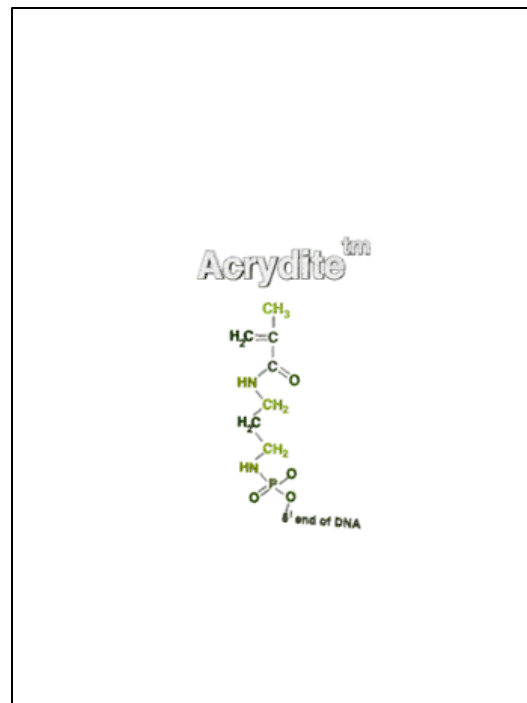
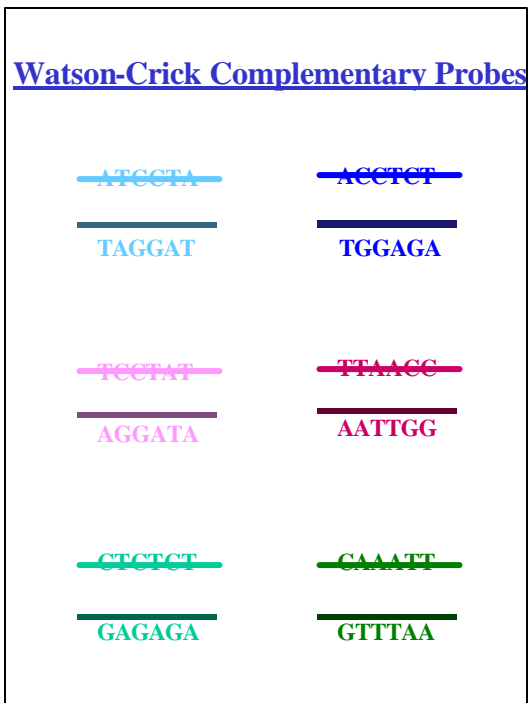
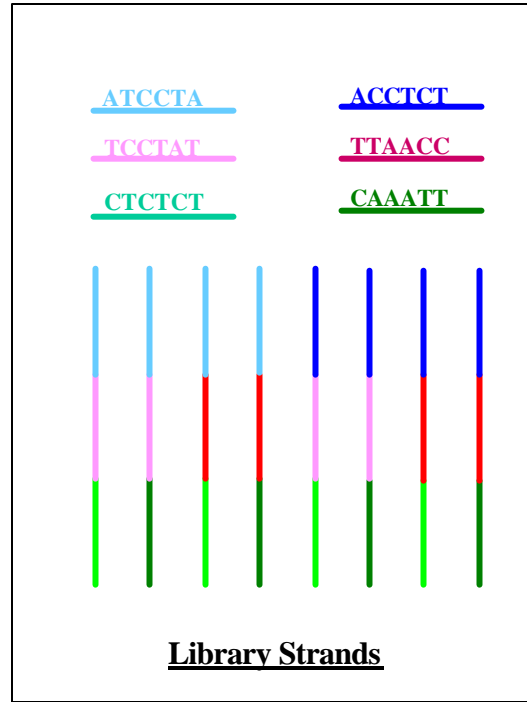
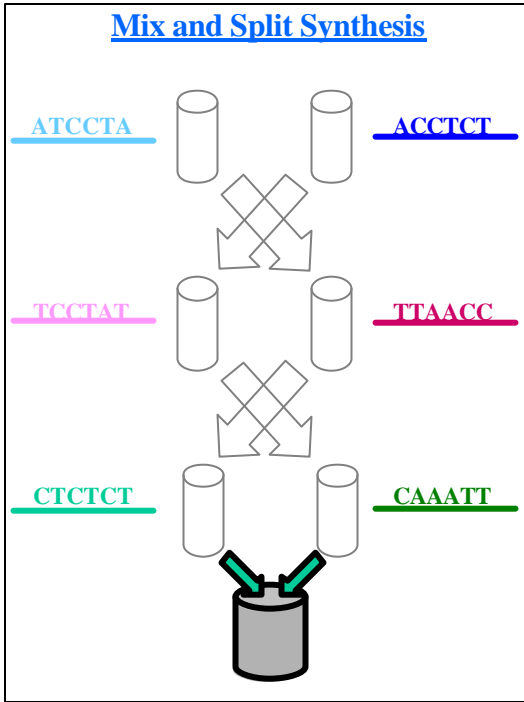
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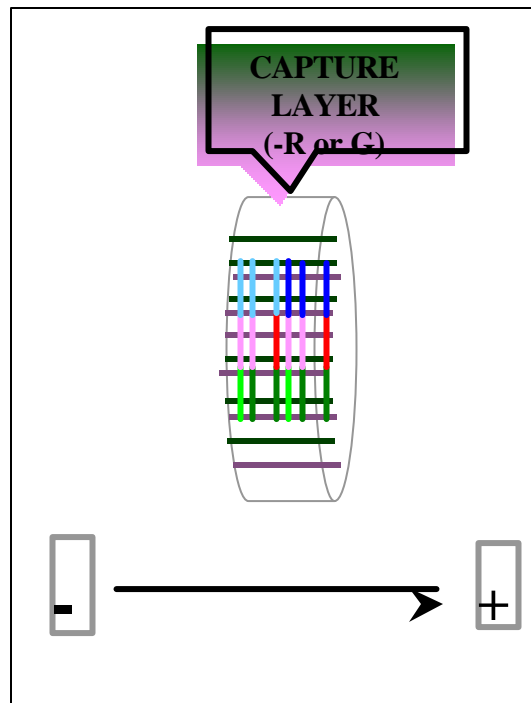
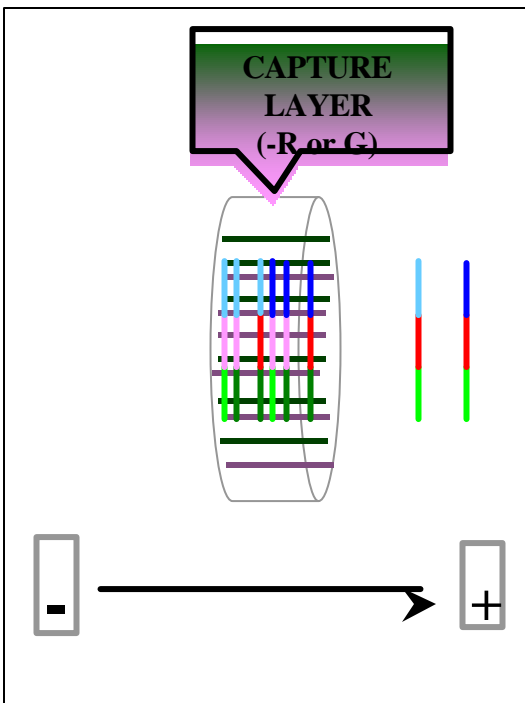
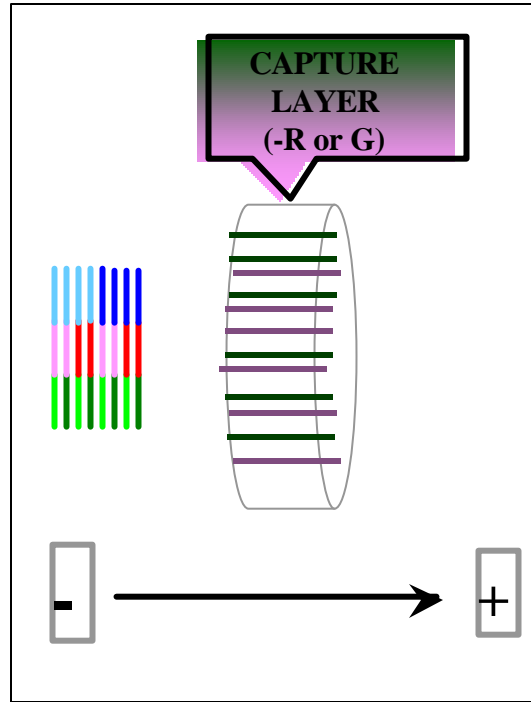
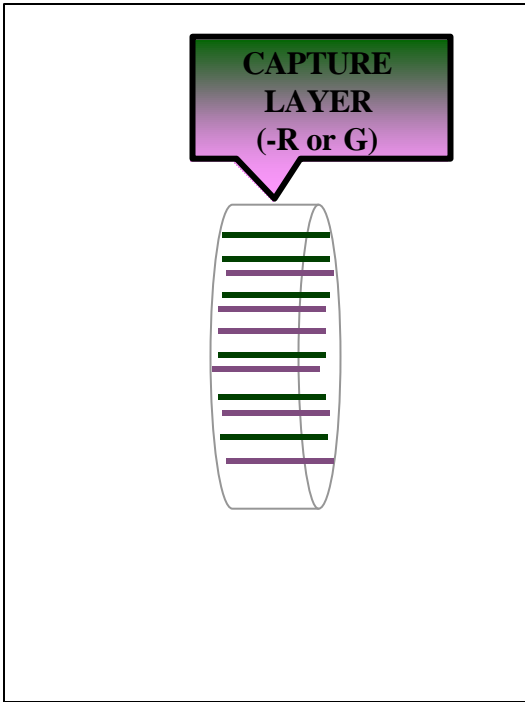
~~TCCTAT~~

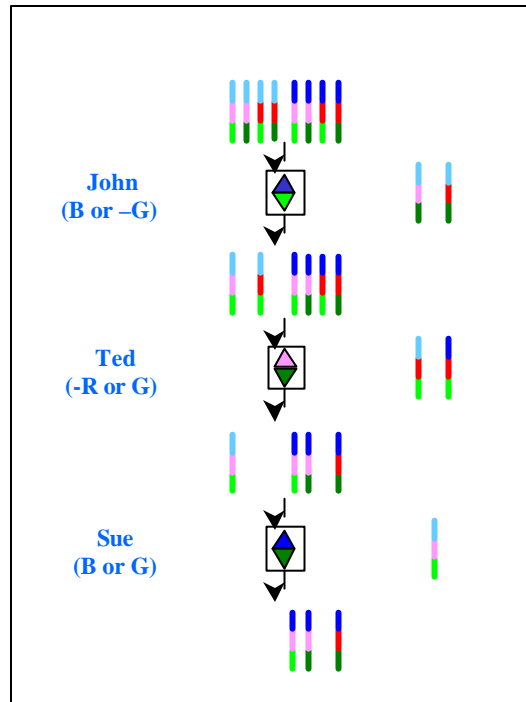
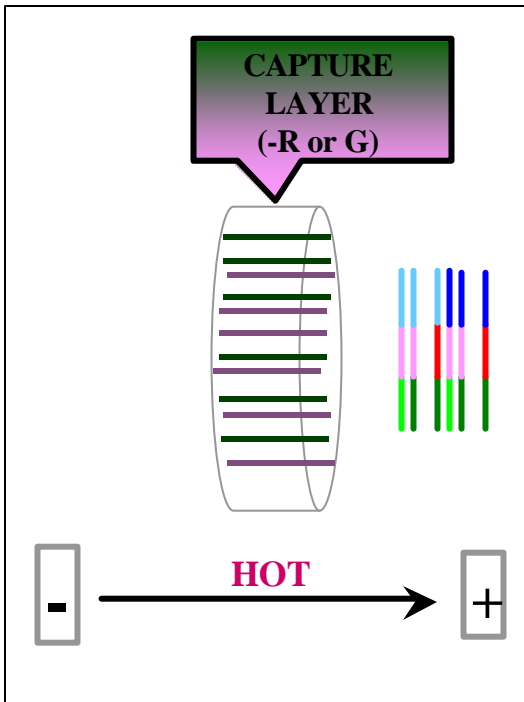
~~TAAACC~~


~~CTCTCT~~

~~GAAATF~~










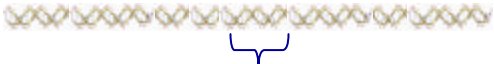
(X₁ or -X₂ or -X₃) and (X₂ or -X₃ or -X₄) and (X₃ or -X₄ or -X₅) and (X₄ or -X₅ or -X₆) and (X₅ or -X₆ or -X₇) and (X₆ or -X₇ or -X₈) and (X₇ or -X₈ or -X₉) and (X₈ or -X₉ or -X₁₀) and (X₉ or -X₁₀ or -X₁₁) and (X₁₀ or -X₁₁ or -X₁₂) and (X₁₁ or -X₁₂ or -X₁₃) and (X₁₄ or -X₁₅ or -X₁₆) and (X₁₅ or -X₁₆ or -X₁₇) and (X₁₆ or -X₁₇ or -X₁₈) and (X₁₇ or -X₁₈ or -X₁₉) and (X₁₈ or -X₁₉ or -X₂₀) and (X₁ or X₂ or X₃) and (X₁ or X₂ or -X₃) and (-X₁ or X₂ or X₃) and (-X₁ or X₂ or -X₃) and (X₁ or -X₂ or X₃)

Science, Vol. 296, Issue 5567, 499-502, April 19, 2002



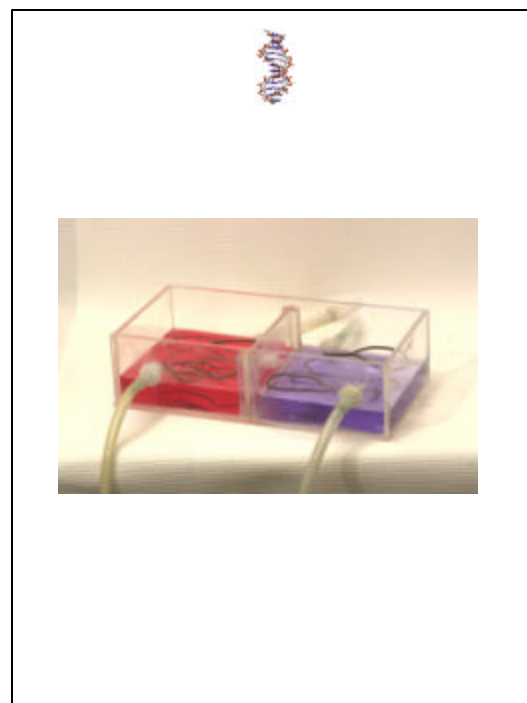
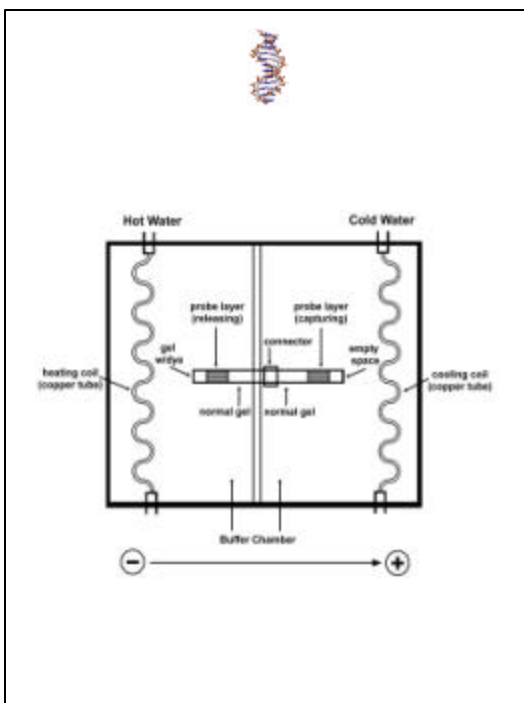
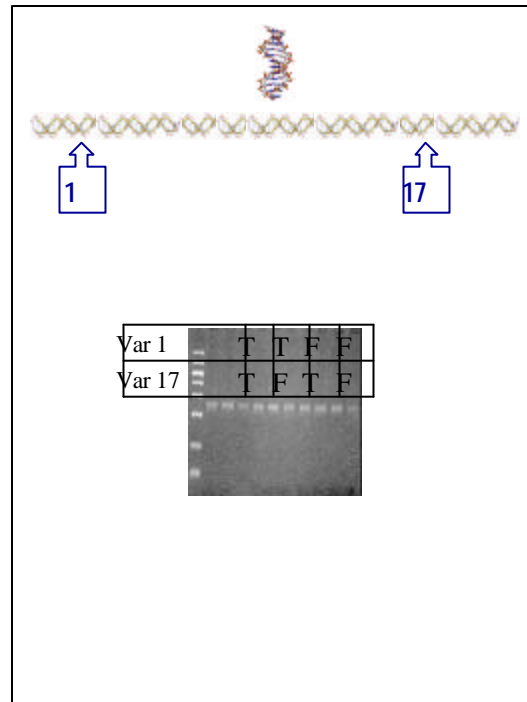
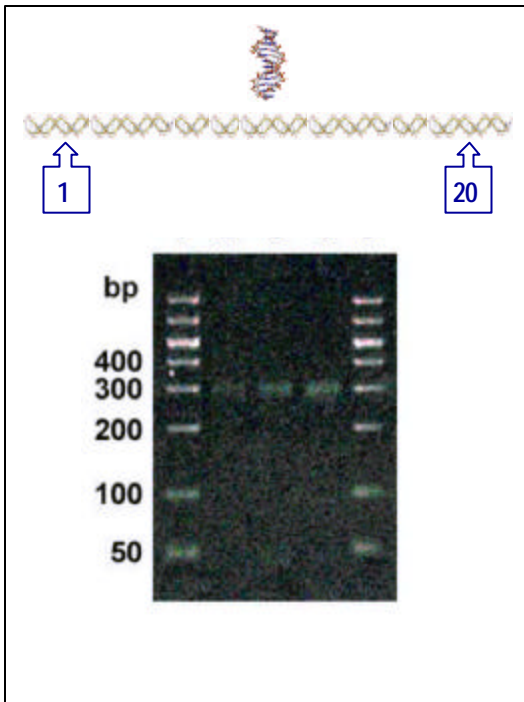
The Library



300 nucs




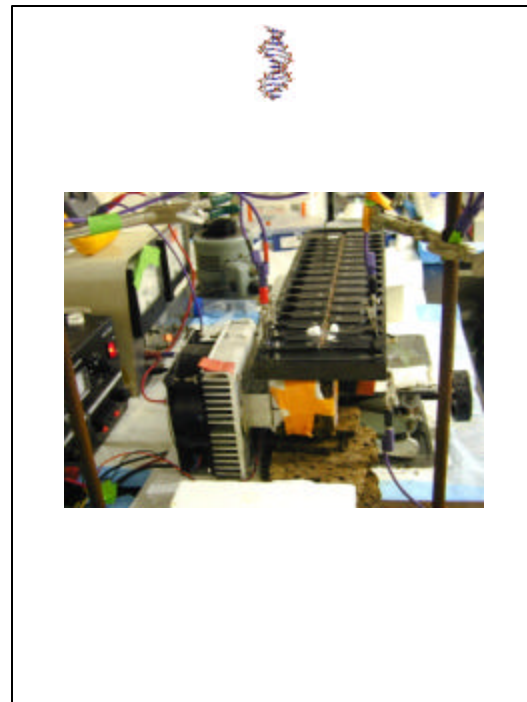
15 nucs per variable

1,048,576 distinct library strands





1
17

Var 1	T	T	F	F
Var 17	T	F	T	F


**“It’s not that
the bear
dances so
well, it’s that**

