

# *Enabling a New Era in Biotechnology*

## **Next Generation DNA Synthesis**



*Michael J. Kamdar, President & CEO*

[www.molecularassemblies.com](http://www.molecularassemblies.com)





**BIOTECHNOLOGY ENTREPRENEURSHIP  
BOOT CAMP 2017**

# **SESSION 2: Project, Product or Company: Assessment and Qualification of Technologies as a Basis for a Business Startup**

June 18, 2017

# Advancing Genomics to Writing DNA



- The next frontier for genomics is:  
***Moving from Reading DNA to Writing DNA***
- Existing chemical method, developed 30 years ago, is limiting the next generation of applications due to:
  - Inability to write gene length DNA
  - Purity and scalability insufficient
  - Cost prohibitive
- Molecular Assemblies is the first to develop the revolutionary DNA synthesis technology-  
***An Enzymatic-based method - the way nature makes DNA***
- World-class team - developed and commercialized the first DNA synthesis method; 12 full-time staff based in San Diego
- Strong patent estate - foundational U.S. patents issued
- Large markets for synthetic DNA - growing up to 20% annually
- Raised \$4.6M Seed Preferred Financing Dec. 2016/May2017

# Successful, Experienced Team



## Michael J. Kamdar: President & Chief Executive Officer

Held executive and/or board positions at Agouron, Warner-Lambert, Pfizer, Anadys, VentiRx, Tobira and Ciclofilin. During this time, Mr. Kamdar has accounted for deal transactions in excess of \$1.0B and raised in excess of \$400M from venture capital and the public capital markets.



## J. William Efcavitch Ph.D.; Chief Science Officer

Senior VP– Applied Biosystems 1981 – 2004 developed eight synthesis, sequence & analysis systems valued at >\$2B revenue, CTO Helicos BioSciences 2004 - 2010 and Sr. VP Affymetrix 2010 – 2012; PhD Biochemistry - Ohio University



## Curt Becker: Chief Commercialization Officer

Co-founder of Applied Biosystems with extensive experience in product development and management, sales and sales management, marketing and customer support management. Since product management of the first automated DNA sequencer which launched the human genome project, Curt has created groups as large as 175 employees from scratch and managed \$20M+ budgets.



## Larry G. Stambaugh: Chairman of the Board

Chairman of the Board or Director of several public and private life science companies. A visionary leader that has built successful management teams, raised over \$500 million of capital in private and public financing and taken companies public in both the U.S. and Europe. He has completed several strategic partnerships and is a leader in corporate governance.



# Chemical Process is No Longer Adequate

## Problem

Length - Limited to 150mers at best

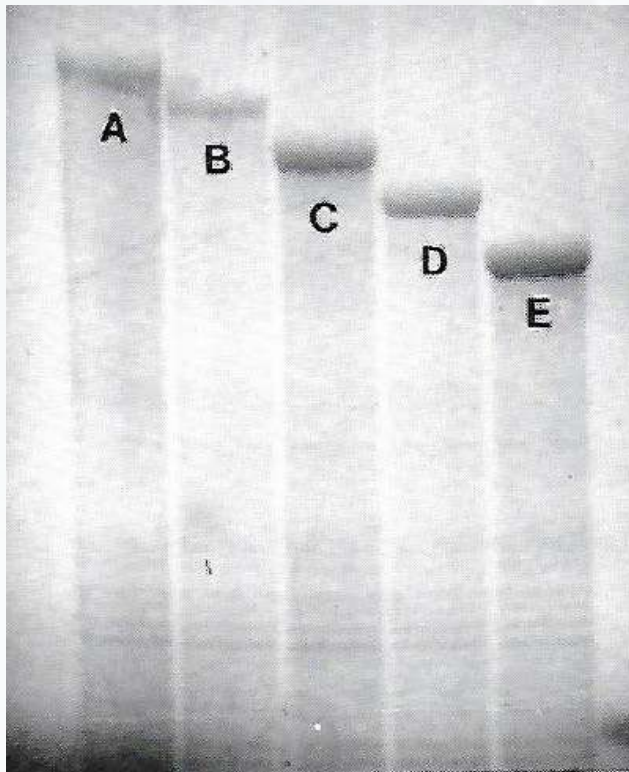
Processing – Numerous post-synthesis steps

Quality- Damaged DNA molecules require error correction

Cost – Only 100x improvement over 30 years

Reliability / Turn around time - homopolymeric runs, significant hairpin structures, tandem repeat regions, or G/C content

Hazardous chemicals in – toxic waste out



**Long oligo synthesis in 1986**

# Enzymatic Process

## Solution



**Terminal deoxynucleotidyl  
transferase**

High Quality – Mild aqueous process

Long - Enzyme capable of 10 to 50x longer

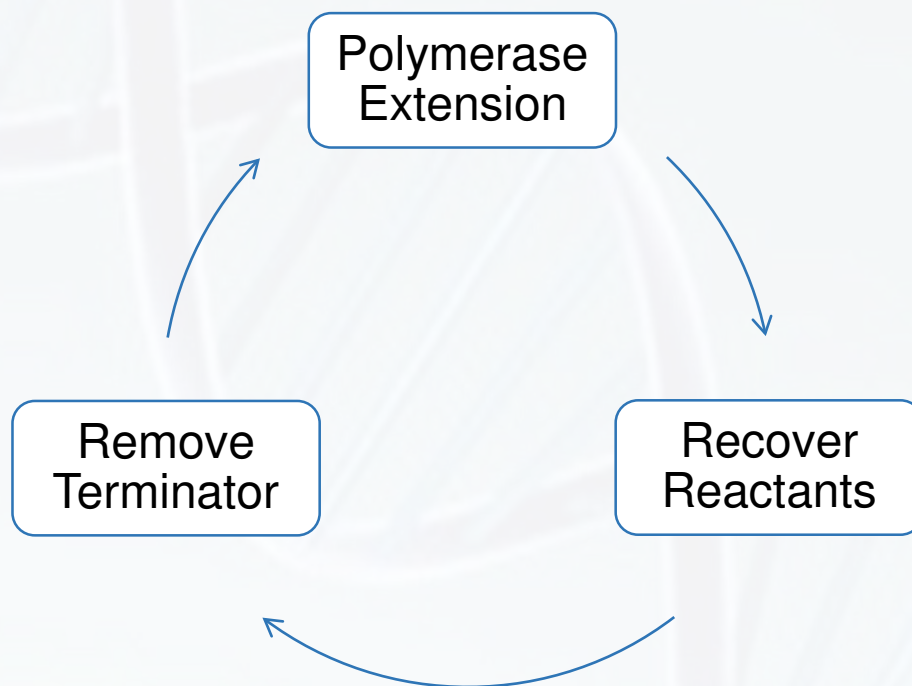
Simple - Eliminates many post-synthesis processing steps

Cost-Effective - Order of magnitude cost reduction w/o array synthesis

Scalable – Applicable over a wide range of synthesis scales

Sustainable – Eliminates toxic waste

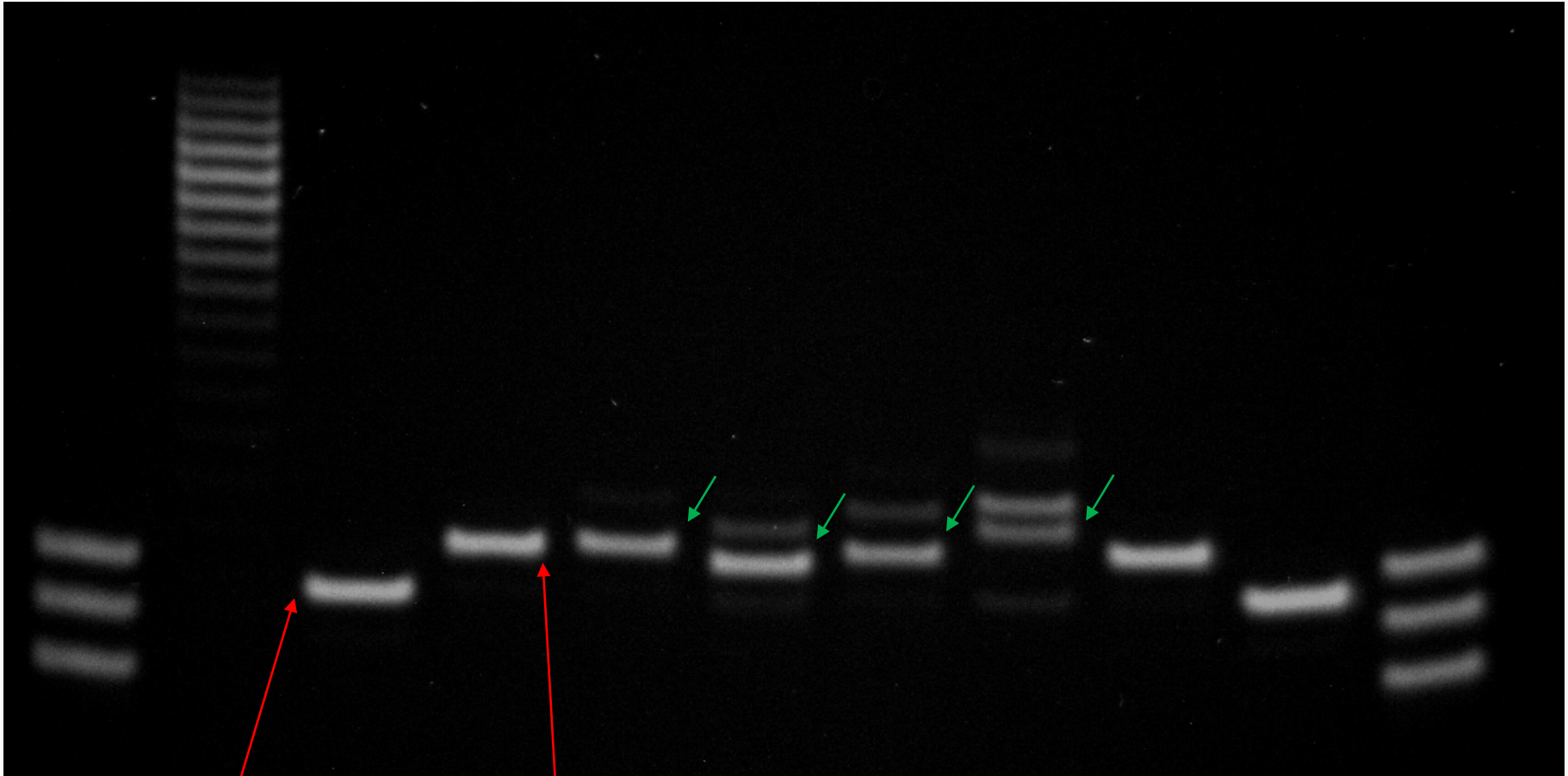
# Next Gen: enzymatic not chemical



- Mild aqueous reagents
- Only two yield determining steps
- Reduced cost of synthesis
- Generates natural DNA at every cycle

# Most Recent Terminator Results

Std. Ladder B-Oligo ddG G(N19) C(H32) T(P79) A(I82) ddG B-oligo Std.



20-mer (starting material)

21-mer control (perfect terminator)

Bio-201 LP



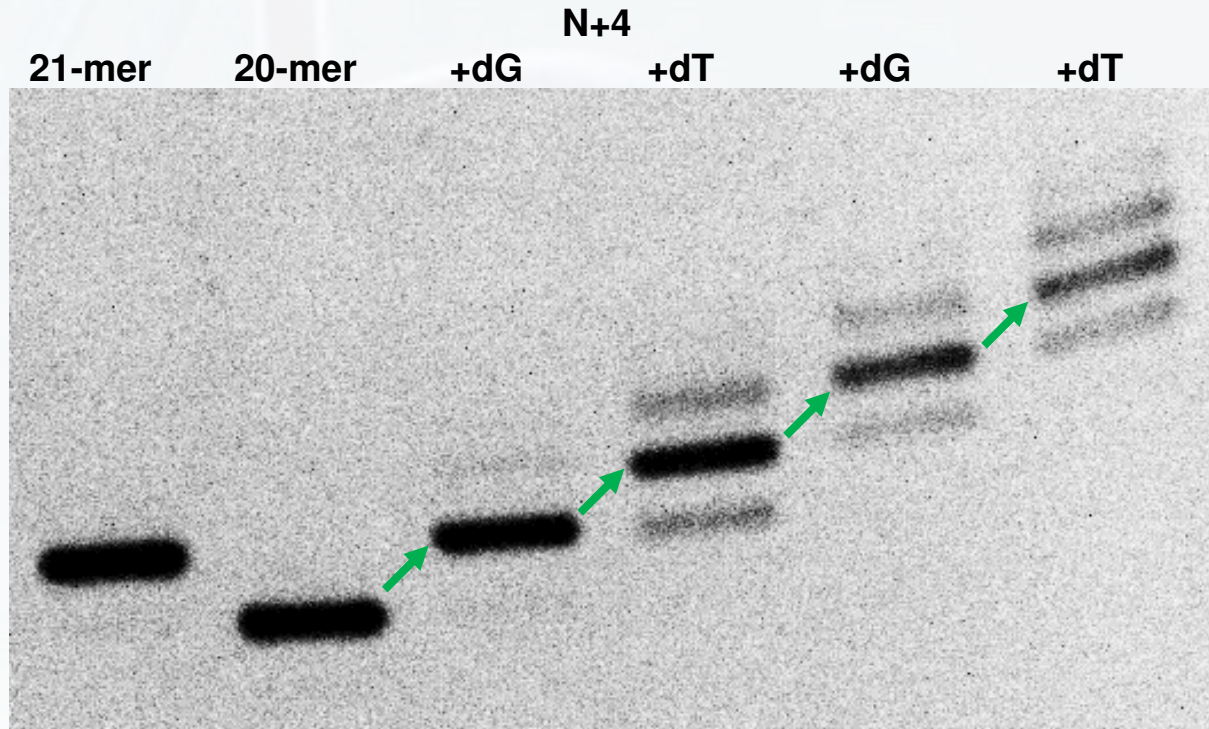


# Reversible Terminators Summary

	MAI ID	Coupling Time	Mono-addition Efficiency	Reversal Conditions
dA	I82	240m @ 150 uM	86%	30m BME/NH <sub>4</sub> CO <sub>2</sub> H 37°C
dG	N19	5 m @ 50 uM	97%	30m BME/NH <sub>4</sub> CO <sub>2</sub> H 37°C
dC	H54	5m @ 50uM	88%	5m BME/NH <sub>4</sub> CO <sub>2</sub> H 37°C
dT	P79	75 s @ 10 uM	86%	5m TCEP 37°C

**Significant progress in 38 months with limited personnel (1 FTE for 24 months)**  
**Most technical requirements of reversible terminators showing proof of principle**  
**New “left side” dATP scaffold under construction**

# *N+4 Results: 20-mer $\rightarrow$ 24-mer (G+T+G+T)*



**Four consecutive reversible terminator additions. Green arrows indicate desired product.**

# Initial Target Market for Reagents – Synthetic Biology

“Writing” Genetic Code *The fastest emerging market segment*



**Market:** The use of DNA to re-engineer cells or organisms to manufacture new products or exhibit new traits.

**Product:** Proprietary reagents capable of producing long, high-quality synthetic DNA, reliably, cost-effectively and sustainably

**Value Proposition:** High-fidelity (quality) – Reliability – Long syntheses – Low cost

**Market Size:** Today >\$400M (2.2B bases) growing 20%

**Market Characteristics:** Six companies supply 70% of global market.



# Synthetic Biology in Genomic Healthcare Applications

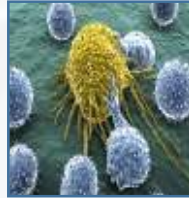
Hottest New Technologies Being Developed Today

Personalized Therapeutics

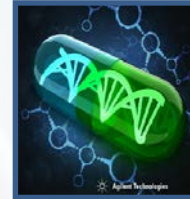


Precision DNA based therapies

Chimeric Antigen Receptor T-Cells



DNA Vaccines



Immuno-propylaxis by gene transfer



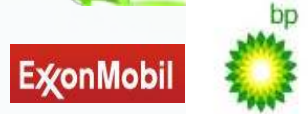
THE SCRIPPS RESEARCH INSTITUTE

## Synthetic Biology - Industrial Applications

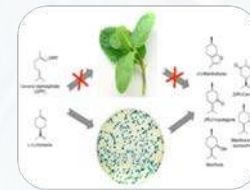
Agriculture



BioFuels



Chemicals



# Next Generation of Genomic Healthcare Applications

Hottest New Technologies Being Developed Today

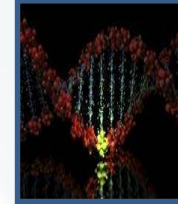
## Personalized Diagnostics



## Non-invasive prenatal screening



## Tumor testing



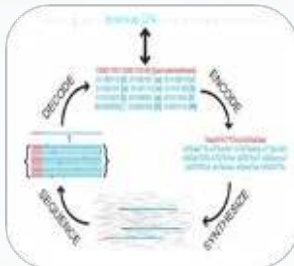
## Genetic disease predisposition



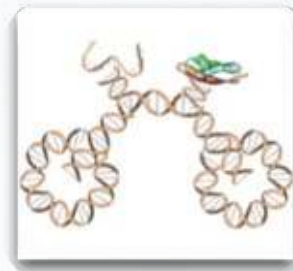
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# Beyond Biology – Industrial Polymer of the 21st Century

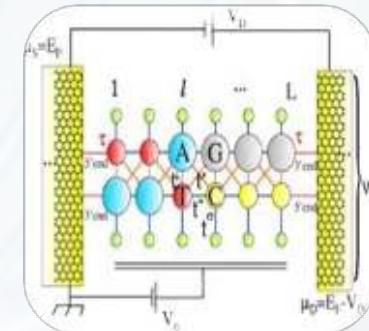
## Information Storage



## Nanotechnology



## Electronics



**MOLECULAR  
ASSEMBLIES**



# San Diego Startup Raises \$4.6M to Advance Enzymatic DNA Synthesis

- Raised \$4.6M in Seed Preferred financing with initial closing announced December 12, 2016
- Investors include:
  - Agilent Technologies
  - Keshif Ventures
  - Alexandria Venture Investments
  - Cavendish Impact Capital
  - Newport Holdings
  - Data Collective Venture Capital (DCVC)
  - Latham
  - Genomics Investment Syndicate



# Strong Intellectual Property Estate

Issued Patent - US 8,808,989 - August 2014



Issued Patent - US 9,279,149 – March 2016

Issued in Europe as EP 2796552 – August 2016



Patents filed broadly cover process, composition and apparatus



Additional applications filed

Outside patent counsel  
Tom Meyers - Partner



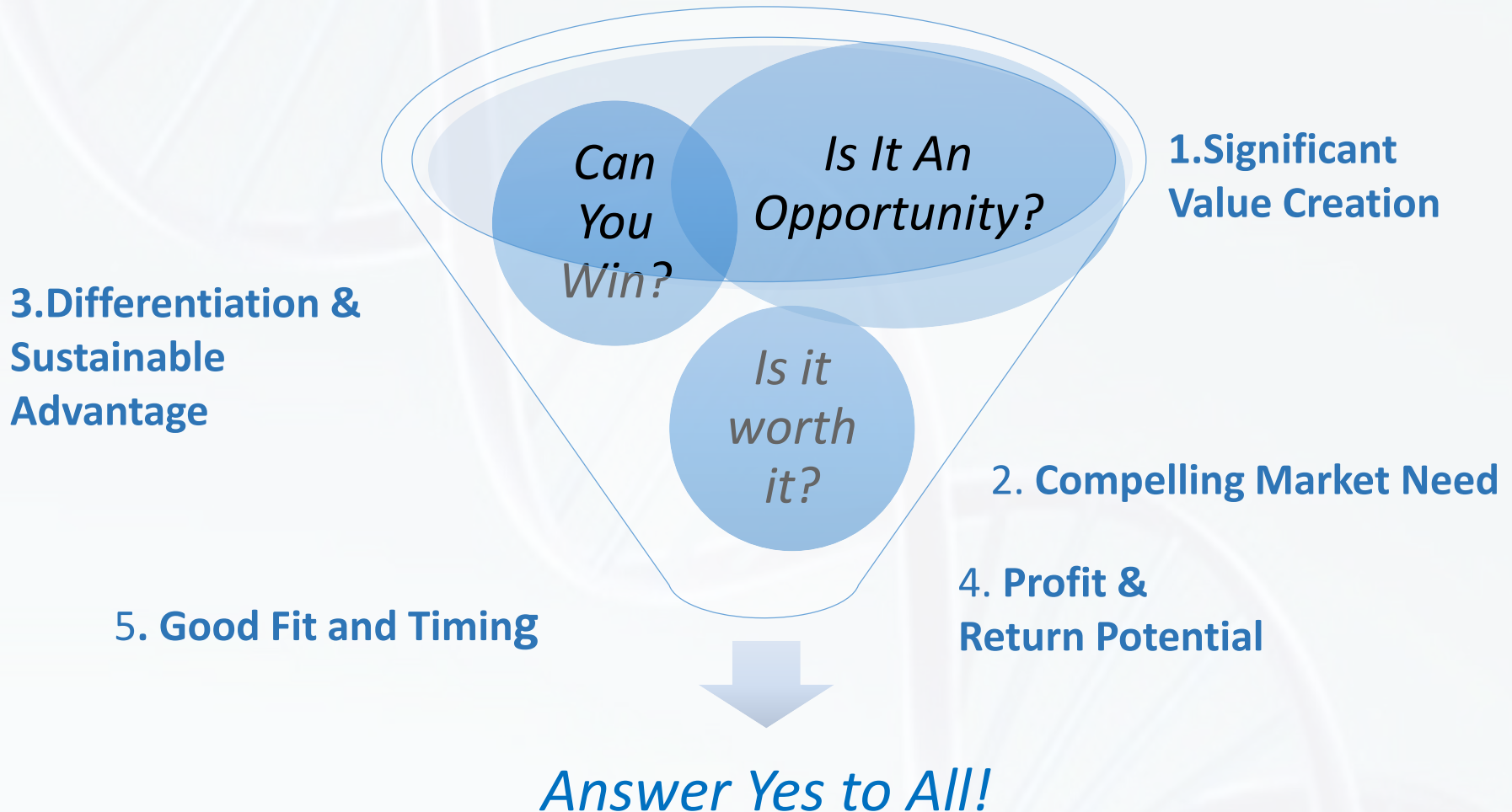
# Advancing Genomics to Writing DNA



- Today's chemical method, developed 30 years ago, launched the genomics field, however it is limiting the next generation of applications
- The next frontier for genomics is:  
**Moving from Reading DNA to Writing DNA**
  - ✓ Long strands (A, C, G & T – the four building blocks of nature's genomes)
  - ✓ Highly Pure, reliable, cost – effective
  - ✓ Scalable manufacturing
  - ✓ Green – Sustainable technology
- Molecular Assemblies' is **developing a revolutionary DNA synthesis technology using an enzymatic method - the way nature makes DNA**
- World-class team - developed and commercialized the first DNA synthesis method
- Strong foundational U.S. patents issued in 2014 and 2016 and other patents applications pending
- Initial large markets for our *proprietary reagents* to produce synthetic DNA - including precision medicine and synthetic biology – growing 20% annually
- Raised \$4.6M Seed Preferred Financing



# Does it Fit the Five Anchors of a Good Opportunity?



# *Multiple Paths to Commercialize*

- License technology to an existing synthetic biology company (i.e. Agilent, ThermoFisher, Illumina)
  - Existing partner infrastructure ensures scale-up and commercialization is not capital intensive
  - Upside returns may be limited to royalties
  - Potential inability to capitalize on markets with greater upside/barriers to entry
- Build it to sell
  - Advance the ball further by developing finished product(s)
  - Greater capital intensity (i.e. requires manufacturing and commercial infrastructure)
  - Greater percentage return/control of your upside

# *Multiple Paths to Commercialize*

- Build a sustainable business on a platform approach
  - Research, development, manufacturing expertise as well as Intellectual Property ensure “Leadership” position in burgeoning markets
  - Highest risk with highest degree of return
  - Revenue generation in 2-3 years creates IPO potential, but M&A more likely

# *Our Answer- Hybrid Company!*

- Opportunity - high
  - Compelling solution to major problem in growing market > \$200M addressable
- Monetary - high
  - Potential for significant revenues and profits
  - Good risk/reward ratio
    - VC and partner fundable and modest amounts
    - Exit potential in investor time horizon with high IRR > 30%
- Competitive advantage - high
  - Unique, differentiable solution
  - Sustainable competitive advantage with strong IP

# *Our Answer- Hybrid Company!*

- Approach – build a sustainable organization with multiple product potential (a platform)
- Advance the science and IP to demonstrate the potential (reduce the risk)
- Build a fundable team
  - Balance science with business (marketing, strategy)
- Line up winning funding sources
  - Angels for risk reduction
  - Strong VC syndicate early
  - Partnerships

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