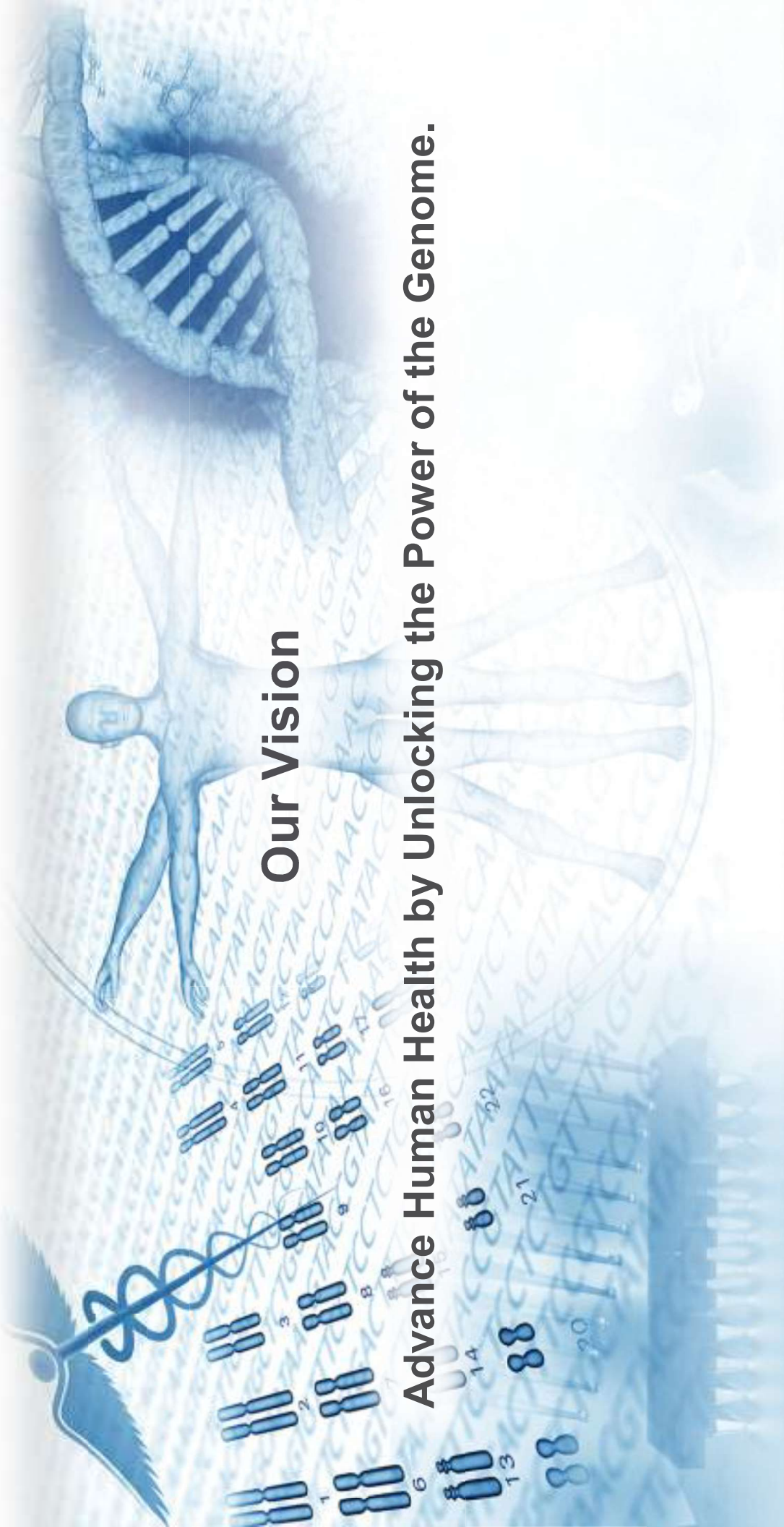




illumina

Next Generation Sequencing Technology

Thomas Patrick Klemm
Sr. Sales Specialist
South APAC
illumina Singapore



Our Vision

Advance Human Health by Unlocking the Power of the Genome.

Our Brand

genetic energy

It's more than genetic analysis. It's the unstoppable drive to know more. To find answers. To be the first. The intangible force that fuels the dynamic Illumina Community. That's genetic energy. The power of the most complete set of genetic analysis tools available. Life sciences research. Diagnostics. Consumer genomics. Limitless applications harnessed with intensity and implemented with imagination. Move forward with us.



Our Background

Leading innovation regionally and globally

- ▶ Founded Fall 1998
 - IPO July 27, 2000
- ▶ Headquartered in San Diego, CA
 - >3,750 employees
 - 20 offices globally
- ▶ Financials
 - 2014 Revenue: \$1.86B
 - 31% growth year over year



illumina®

Scientists Choose Awards
The Best of the Best
Fast Best
Product
Business System

2010

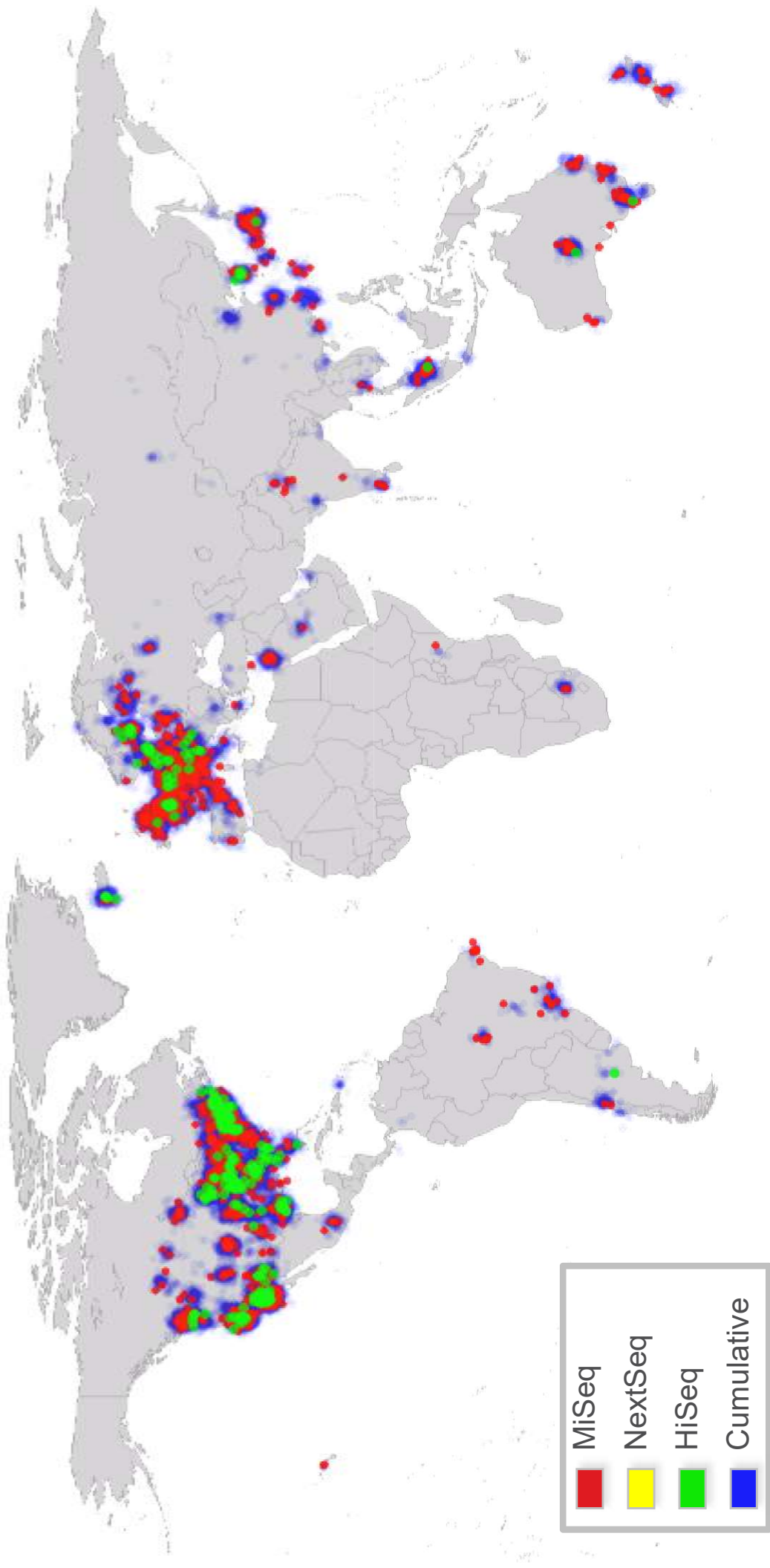
Our Responsibility

Illumina engages to lead in our communities

- ▶ Creating a great employee environment
- ▶ Being environmentally conscious
 - Energy, recycling, pollution-control programs
 - LEED certified facilities
- ▶ Engaging in the community around our vision
 - STEM education
 - Oncology and Genetic Disease
 - Partnerships with local hospitals (Rady)
 - Amphitheater program
- ▶ Giving back
 - iHope Program
 - Agriculture Greater Good Initiative
 - Cystic Fibrosis Great Strides
 - Canary Challenge, Run for Hope, Singapore Cancer Society
 - AJs Kids Crane



Global Customer Base





>90% of the world's sequencing data have been generated using Illumina sequencers.

Illumina Customers

A broad range of leading institutions globally

Government



Biotechnology



Academic

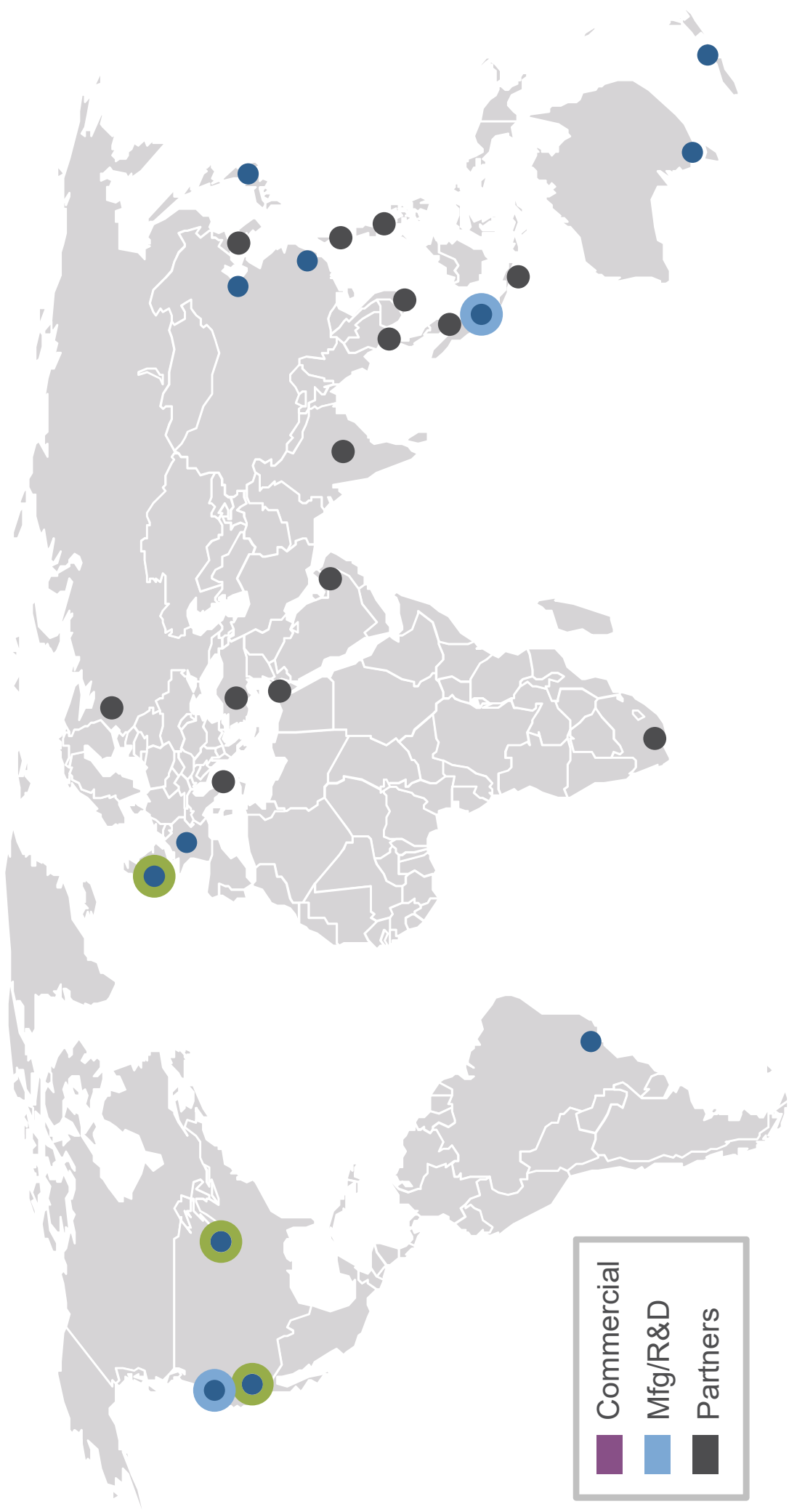


Healthcare



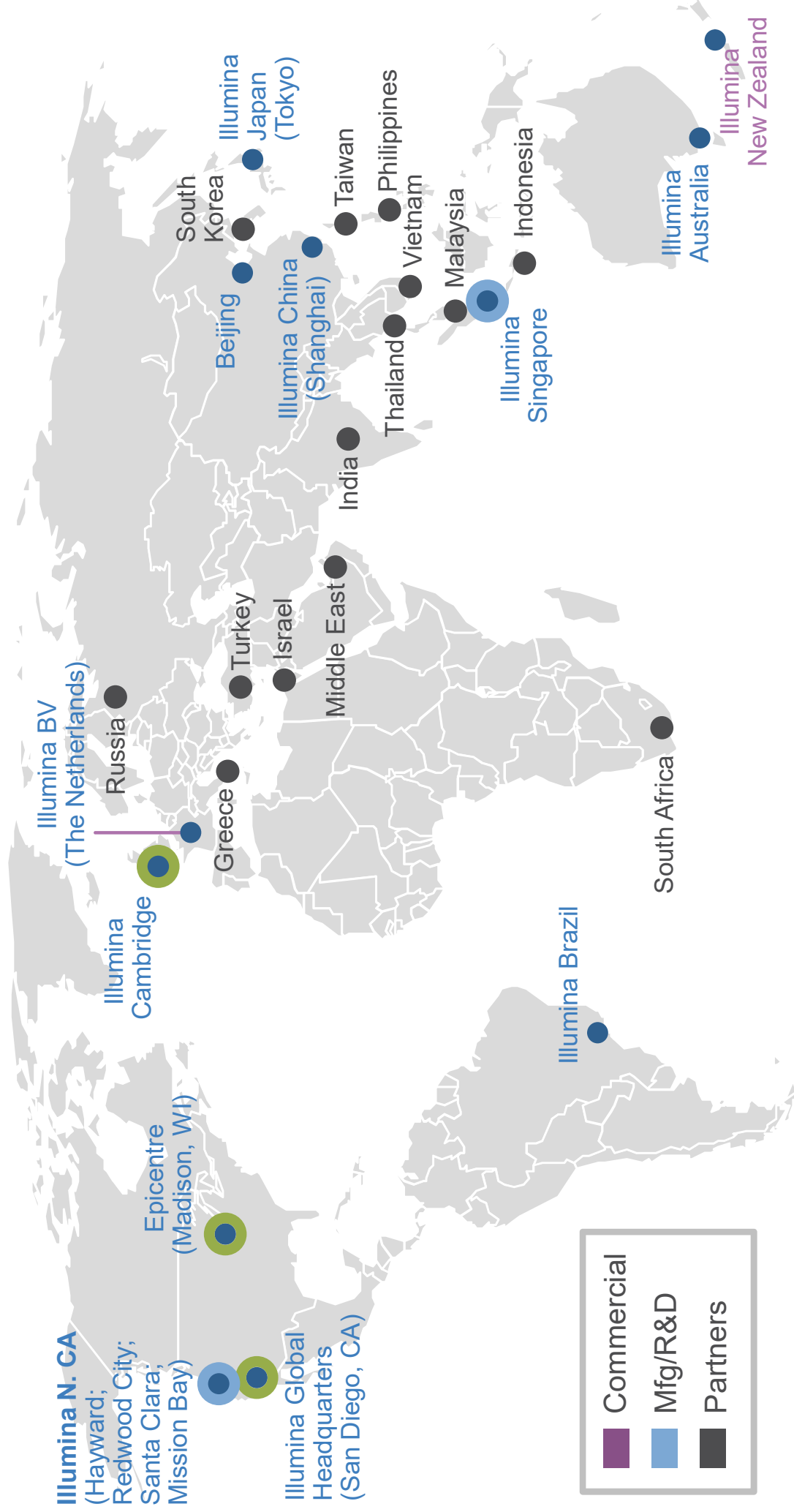
Global Organization

Multi-site manufacturing, R&D, sales, service & support

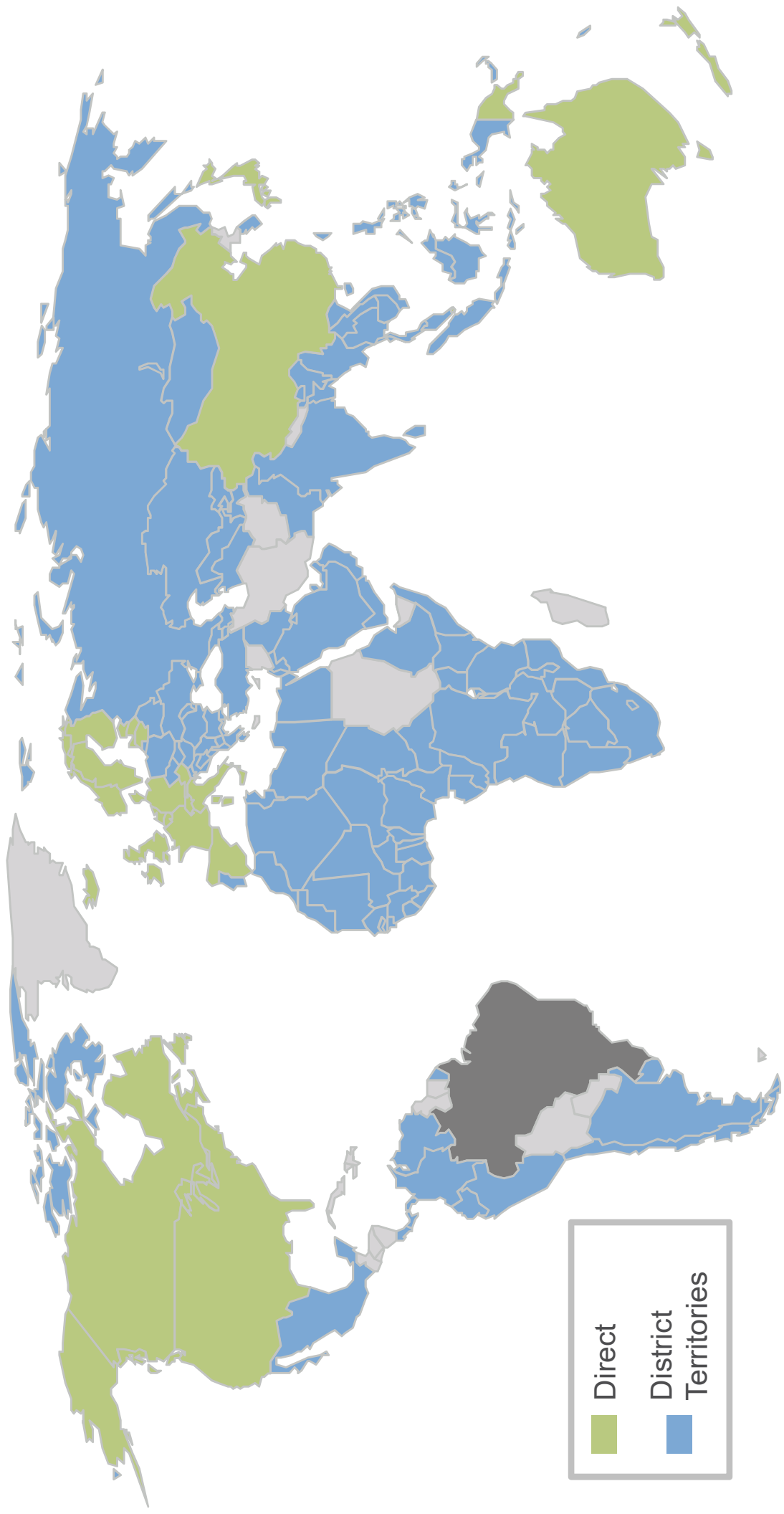


Global Organization

Multi-site manufacturing, R&D, sales, service & support



Our Distributor Partners



Corporate Locations

Over 1.2M Square Feet of "Pumpkin Footprint" Around the World

Illumina Inc.

- > 750,000 sq. ft.
- San Diego, CA
- Corporate HQ



Illumina Ltd.

- 64,220 sq. ft.
- Chesterford, UK
- EU Headquarters



Illumina Shanghai

- 2,800 sq. ft.
- China
- Commercial



Epicentre

- 45,000 sq. ft.
- Madison, WI
- Subsidiary



Illumina China

- 2,200 sq. ft.
- Beijing
- Commercial



1998 1999

2009

2010

2013



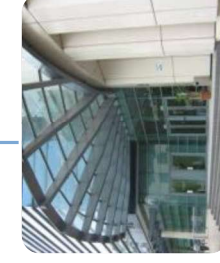
Illumina Hayward

- October 1999
- 110,000 sq. ft.
- Hayward CA



Illumina Japan

- Tokyo, Japan
- Commercial



Illumina Singapore

- 78,200 sq. ft.
- Singapore
- Manufacturing, Commercial



Illumina Brazil

- 2,690 sq. ft.
- Commercial



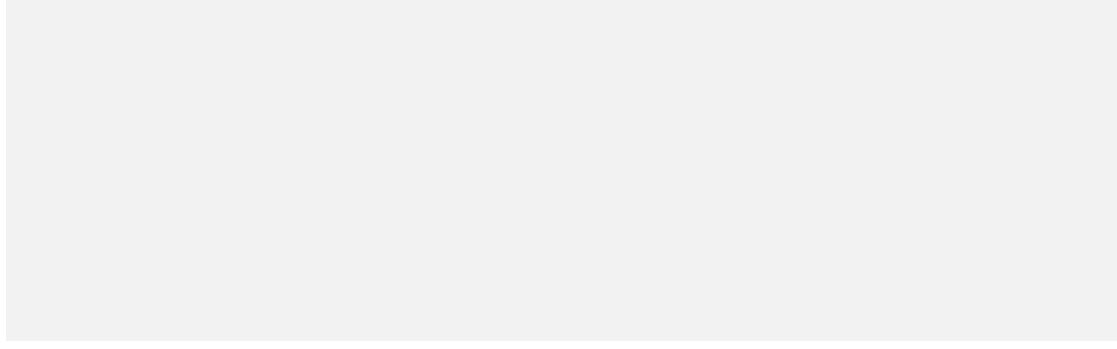
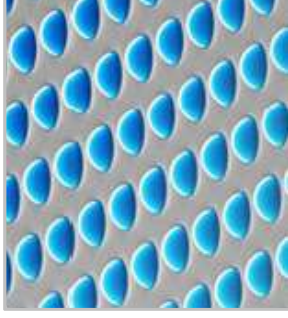
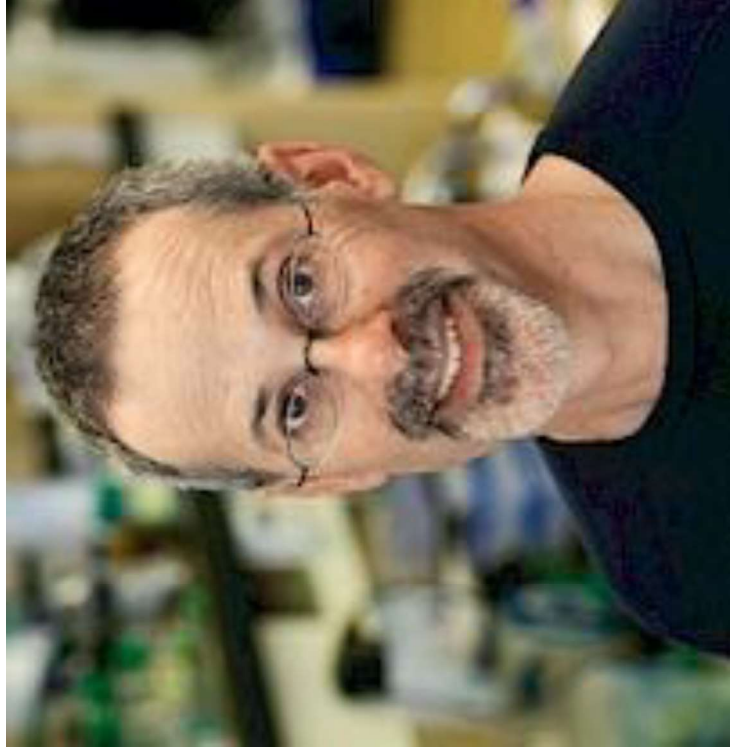
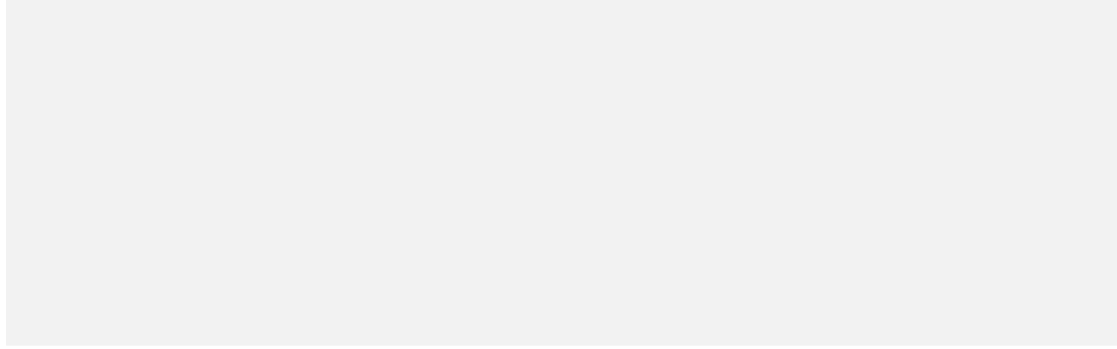
ALL

- 22,600 sq. ft.
- Verinata**
- 41,450 sq. ft.
- BlueGnome**
- 9,720 sq. ft.

About Our History



The Concept of Illumina

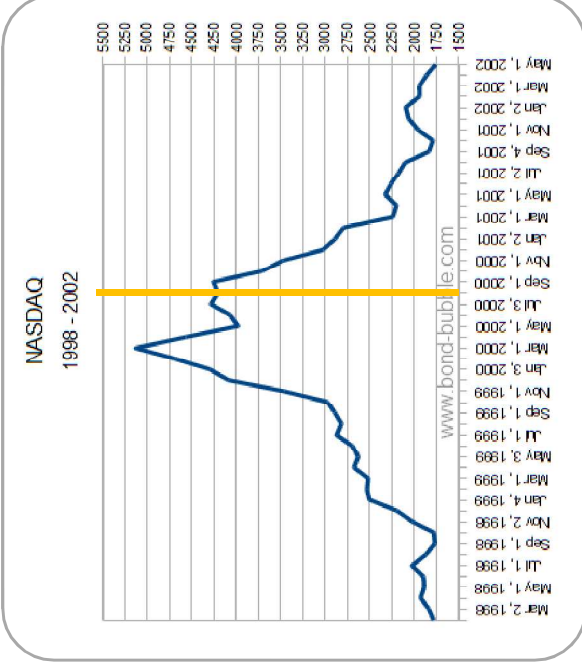


A Company Defined by Passion and Purpose

Passion



Purpose



Project



A Decade of Progress

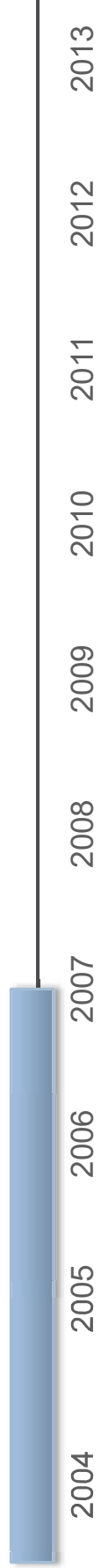
Towards our Vision

1,536

2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

A Decade of Progress

Towards our Vision



A Decade of Progress

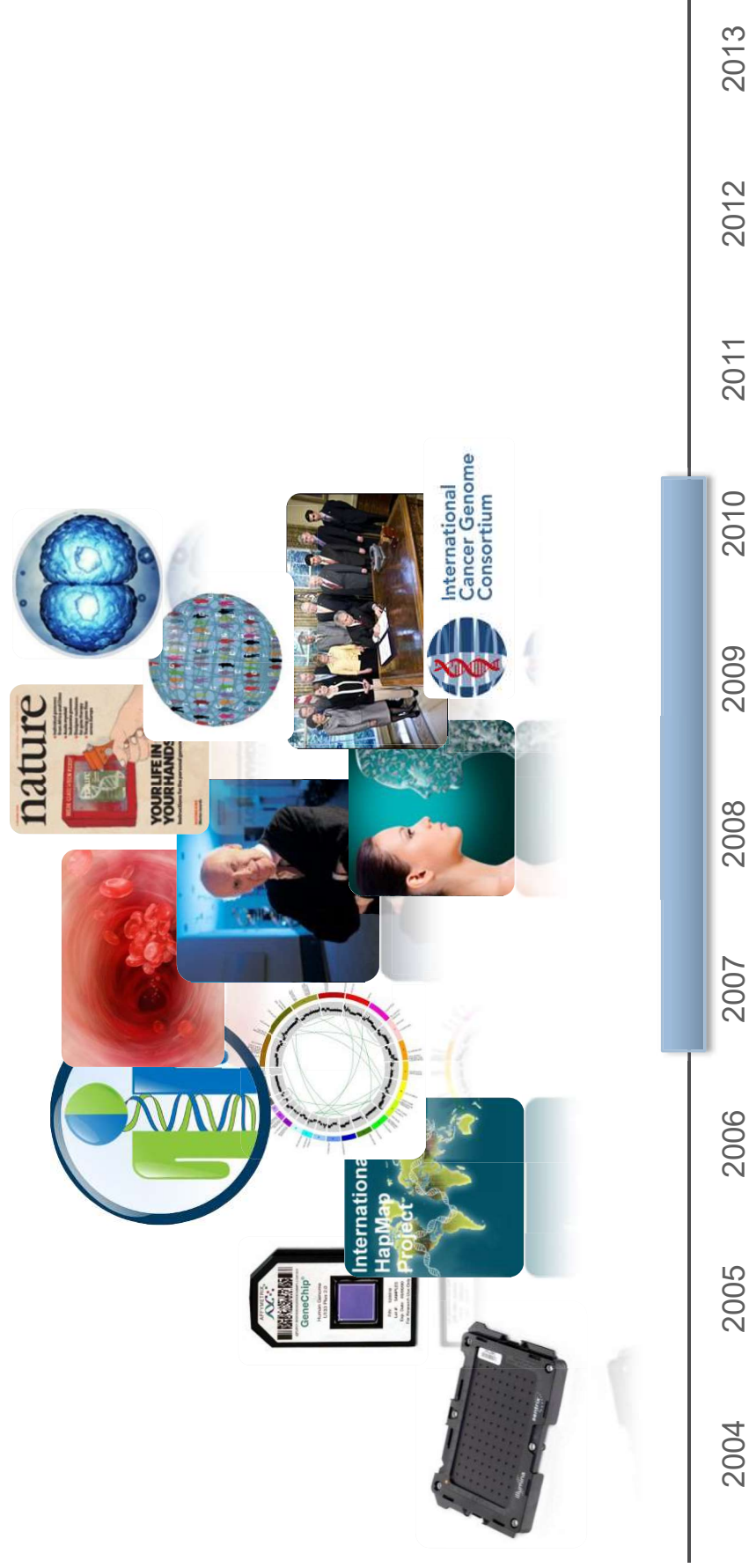
Towards our Vision

10G

2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

A Decade of Progress

Towards our Vision



A Decade of Progress

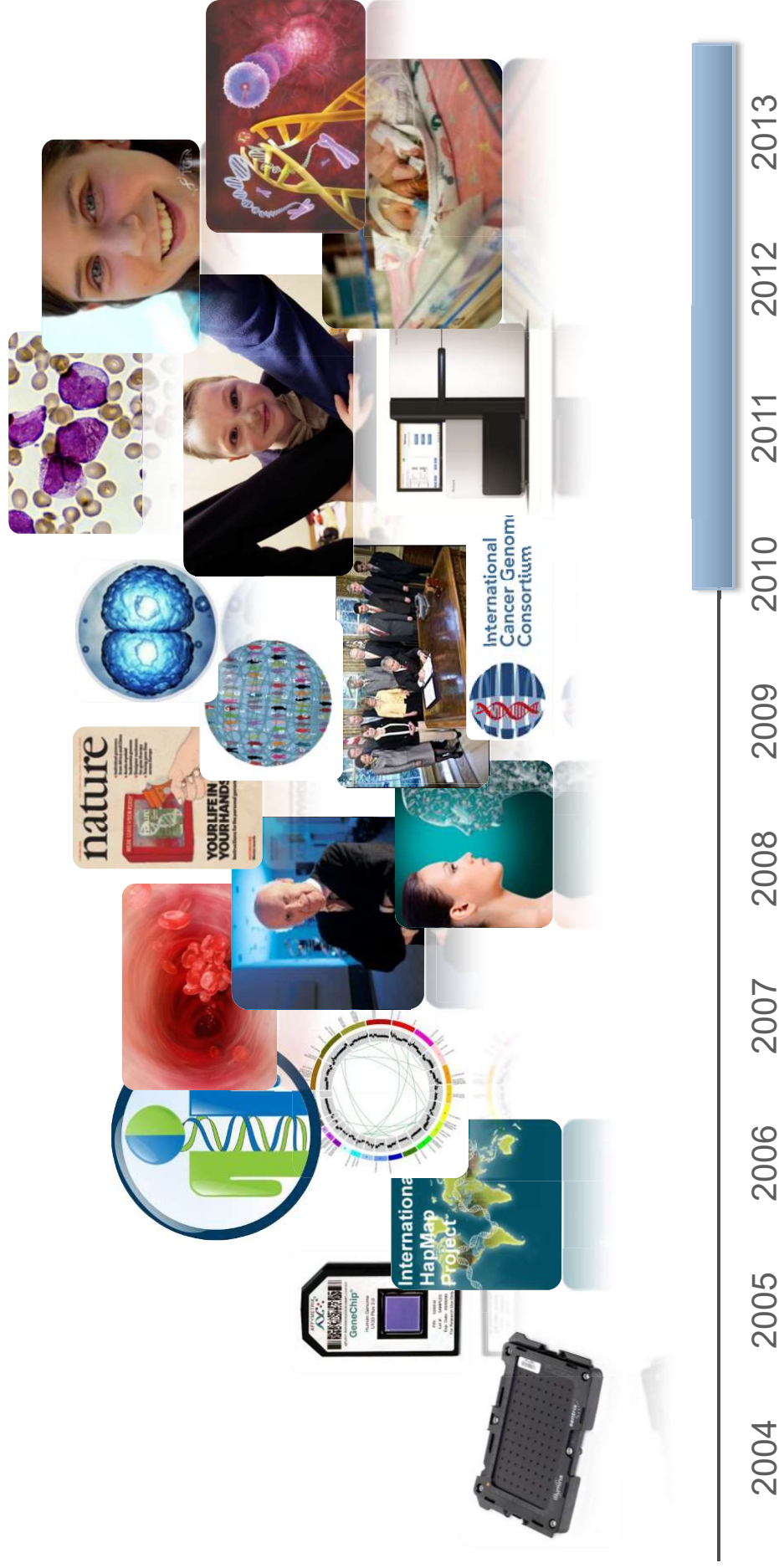
Towards our Vision

2000G

2004 2005 2006 2007 2008 2009 **2010** 2011 2012 2013

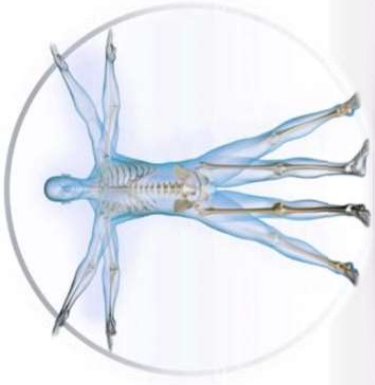
A Decade of Progress

Towards our Vision



2003

Human Genome Project



\$3B

2006

1st individual genome



\$20M

2007

1st NGS genome



\$2M

2008

1st 30x genome



\$200K

2010

1st sub-

\$10K

genome



2014

1st

\$1,000

genome



from **\$20M** to **\$1K** Human Genome

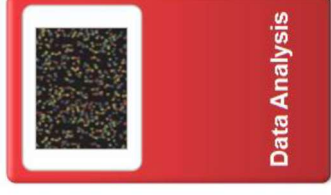
20,000X drop

Agenda

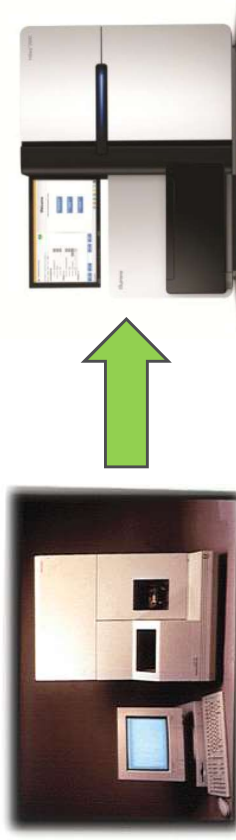
1. What is sequencing?



3. Illumina sequencing technology



2. Evolution of sequencing



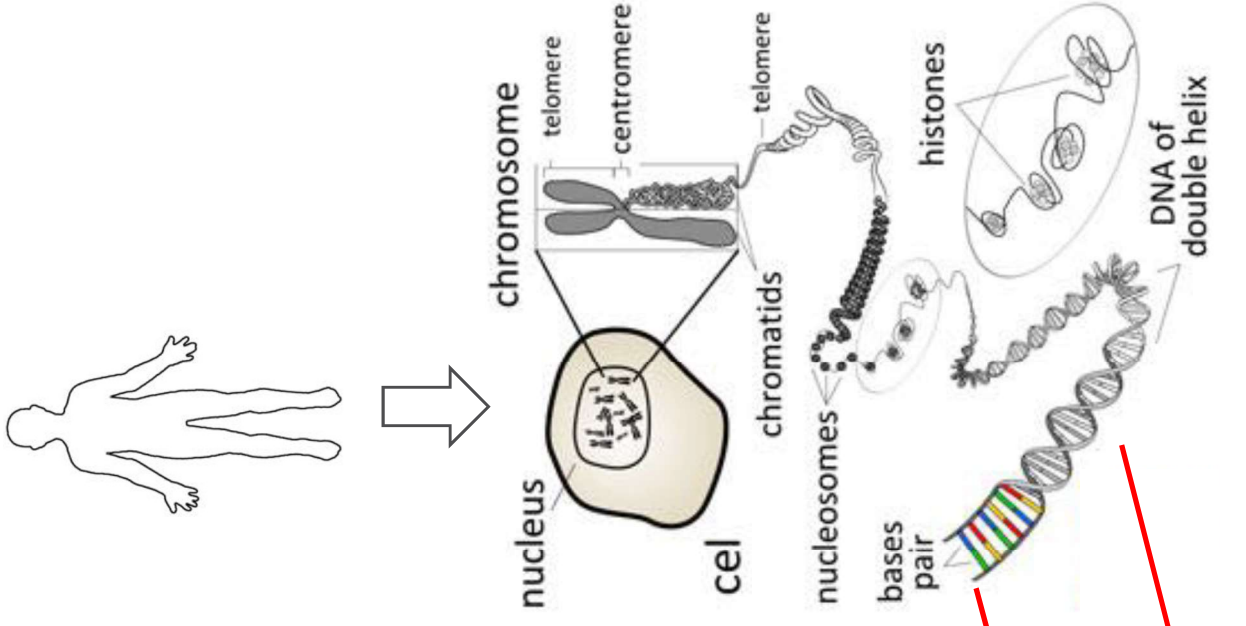
4. Illumina sequencing platforms

Sequencing

| | | |
|---|---|---|
|  MiSeq Focused power, speed and simplicity for targeted and small genome sequencing. REQUEST PRICING |  MiSeqDx Focused Dx power. The first FDA-cleared IVD next-generation sequencing system. REQUEST PRICING |  NextSeq 500 Flexible power. Speed and simplicity for everyday genomics. REQUEST PRICING |
|  HiSeq 2500 Production power. Power and efficiency for large-scale genomics. REQUEST PRICING |  HiSeq X Ten Population power. Maximum throughput and lowest cost for population-scale sequencing. REQUEST PRICING |  NovaSeq Unrivaled simplicity. Library prep reimaged. Coming soon. LEARN MORE |

What is Sequencing?

- Reading of genetic information of:
 - Whole genome
 - Interested section of a genome
 - Etc.



ACTGGCGATCGATCGATG

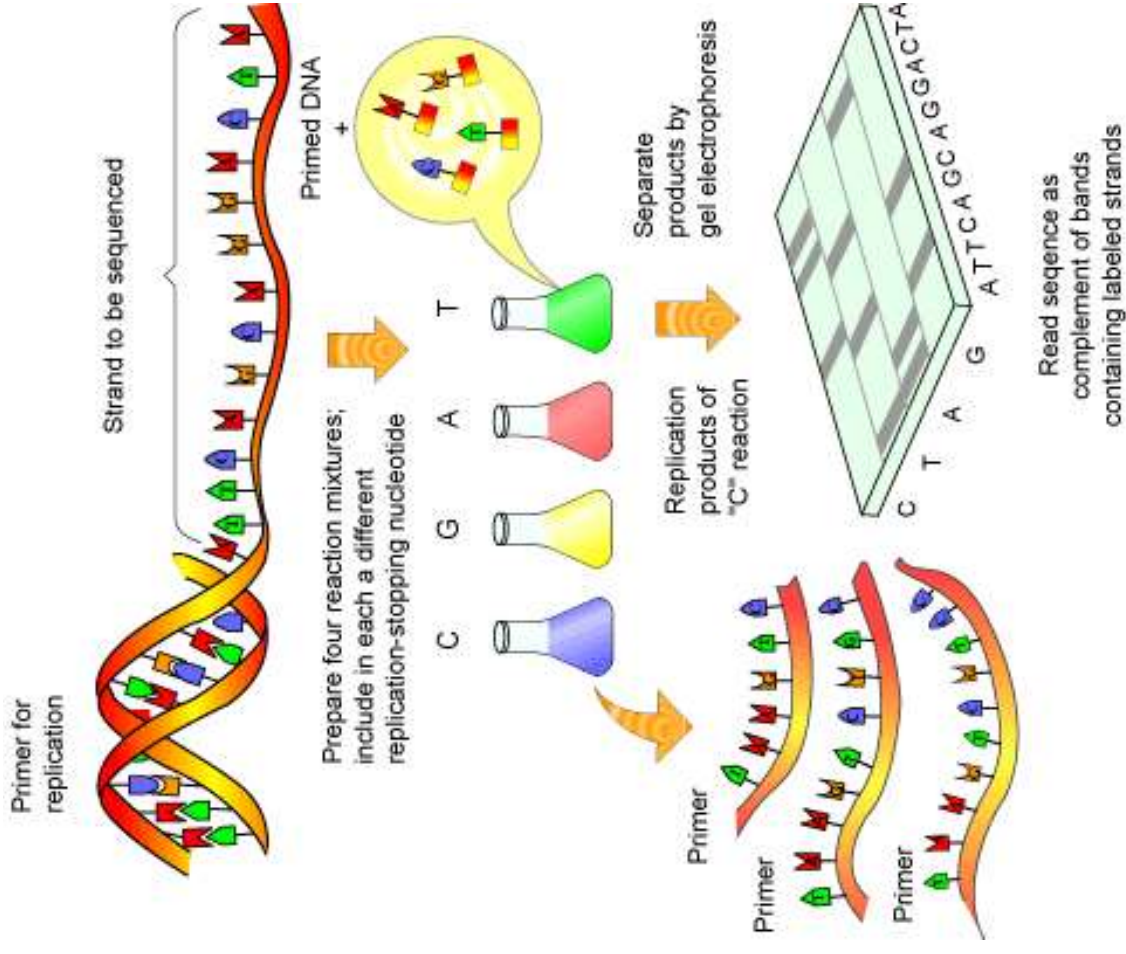
Evolution of Sequencing

Since 1970s...



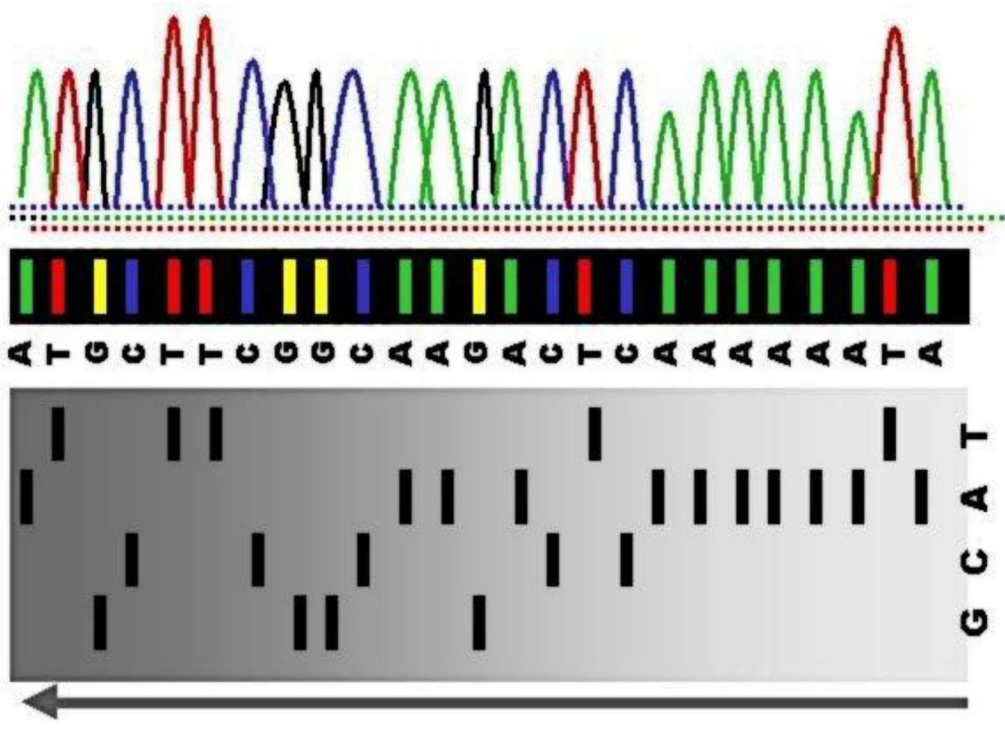
Evolution of Sequencing

- Started in the 1970s
- Gel electrophoresis sequencing
 - Artificially ‘copy’ DNA
 - “Copied” DNA strands incorporate fluorescent dyes
 - Gel separates by size
 - Read the strand sequence in order of length

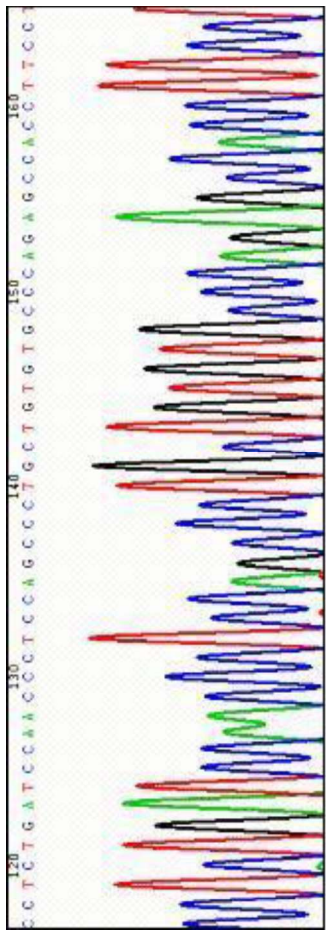
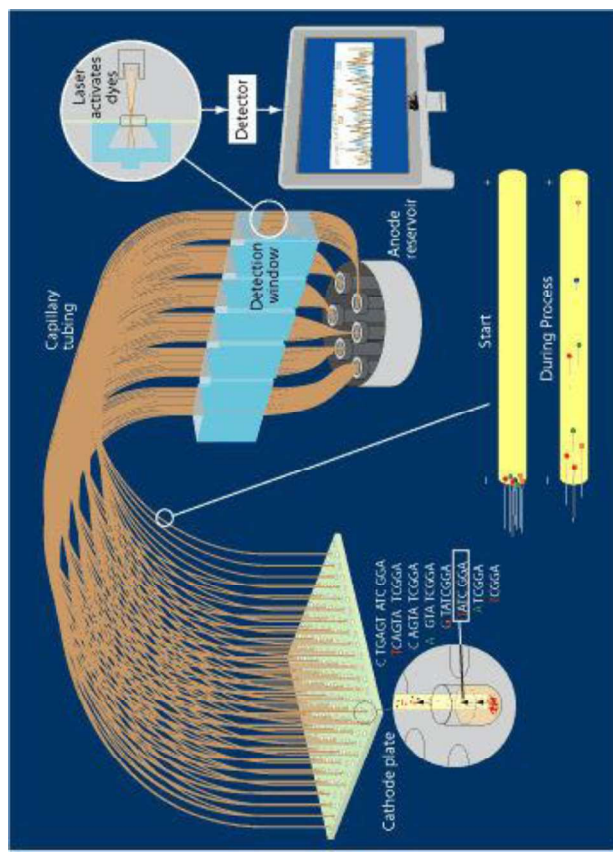


Evolution of Sequencing

Slab Gel Sequencing

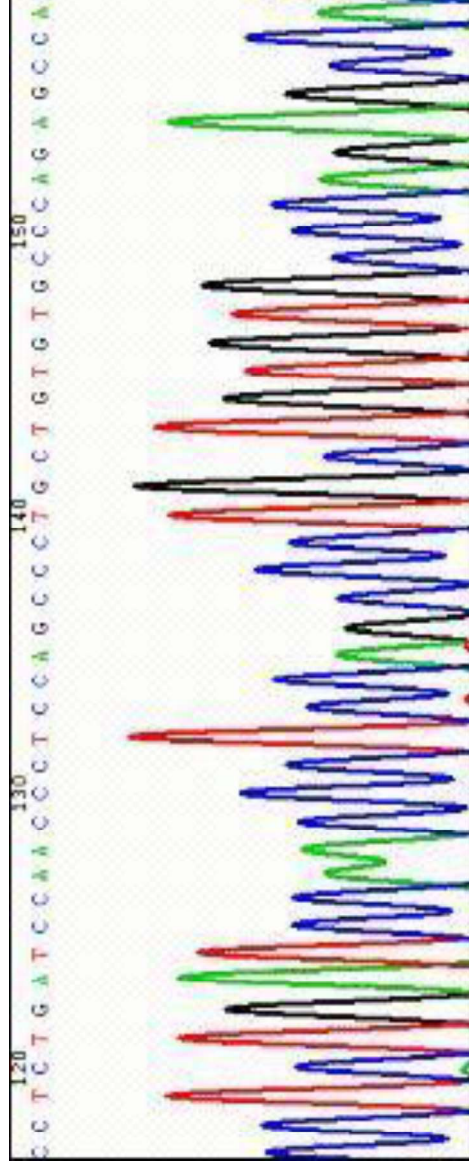


Capillary Electrophoresis (CE) Sequencing



First Generation automation in 1999: Capillary Electrophoresis (CE)

- ▶ Use tiny capillaries instead of gels to separate DNA
- ▶ Able to sequence more DNA molecules
- ▶ Automated “ordering” to get sequence



Pre-Historic Sequencing... about 2005

1 year Before Illumina's Genome Analyzer...

- ▶ Large Sequencing Factories
- ▶ 100 to 150 Capillary Sequencers
- ▶ Room filled of automated machines
- ▶ Dozens of lab personnel
- ▶ Multi-million dollar budgets



Broad, WashU, Sanger,
Baylor, Venter, JGI, etc.

**Output of
3 to 5 Gb per month**

Gb = Gigabases = 1 billion bases of DNA (A,C,G,T)

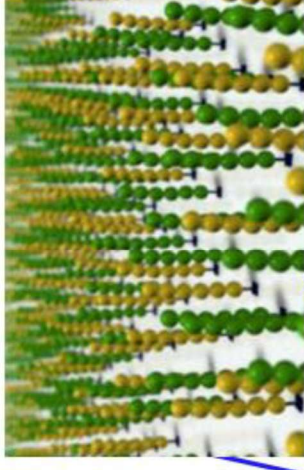
Next-Generation Sequencing

- ▶ Illumina acquired Solexa in 2007
- ▶ Using “clusters” instead of capillaries
- ▶ Like running millions of gels at once
 - Each cluster is like a gel
- ▶ Massive parallel sequencing
- ▶ Faster
- ▶ Cheaper

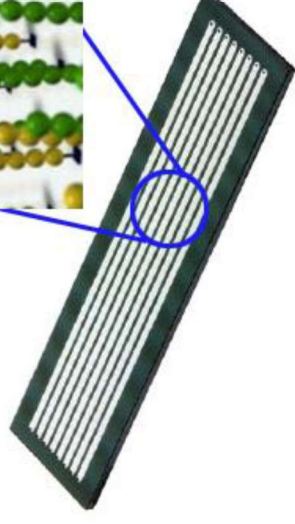


ATCGA...

TCGA... ACTGGCG...



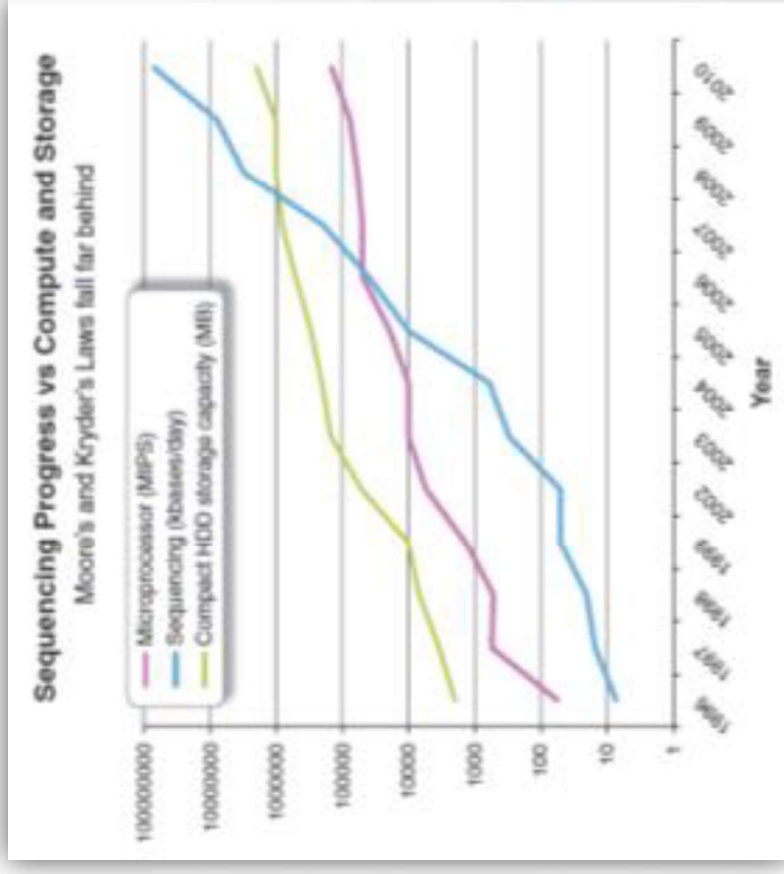
TCGATG...



... replaced with a flow cell



- ▶ Millions of DNA clones grown directly inside these flow cells
- ▶ Millions of these DNA clones sequenced in parallel and simultaneously



Sanger : Illumina NGS

Greater Coverage – Lower Limit of Detection

Illumina NGS

```
ATCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
ATCTTCCATCTCCGACAAAGCCCTATCAGTACATGCTGCAGGTGAGAG  
ATCTTCCATCTCCGACAAAGCCCTATCAGTACATGCTGCAGGTGAGAG  
ATCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG  
TCCTTCCATCTCCGACAAAGCCCGA TCAGTACATGCTGCAGGTGAGAG
```

20 – 10,000X coverage

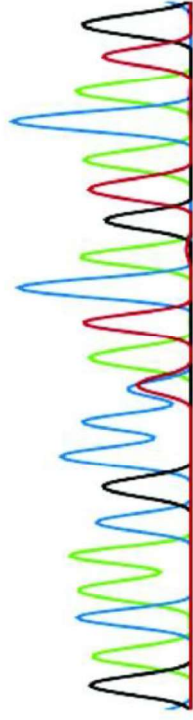
Digital

Massively parallel

Like “Millions of Sanger reactions”

LOD < 5% due to greater coverage

Sanger Sequencing



G A C A A C G C C T A T C A G T A C A T G

2X coverage

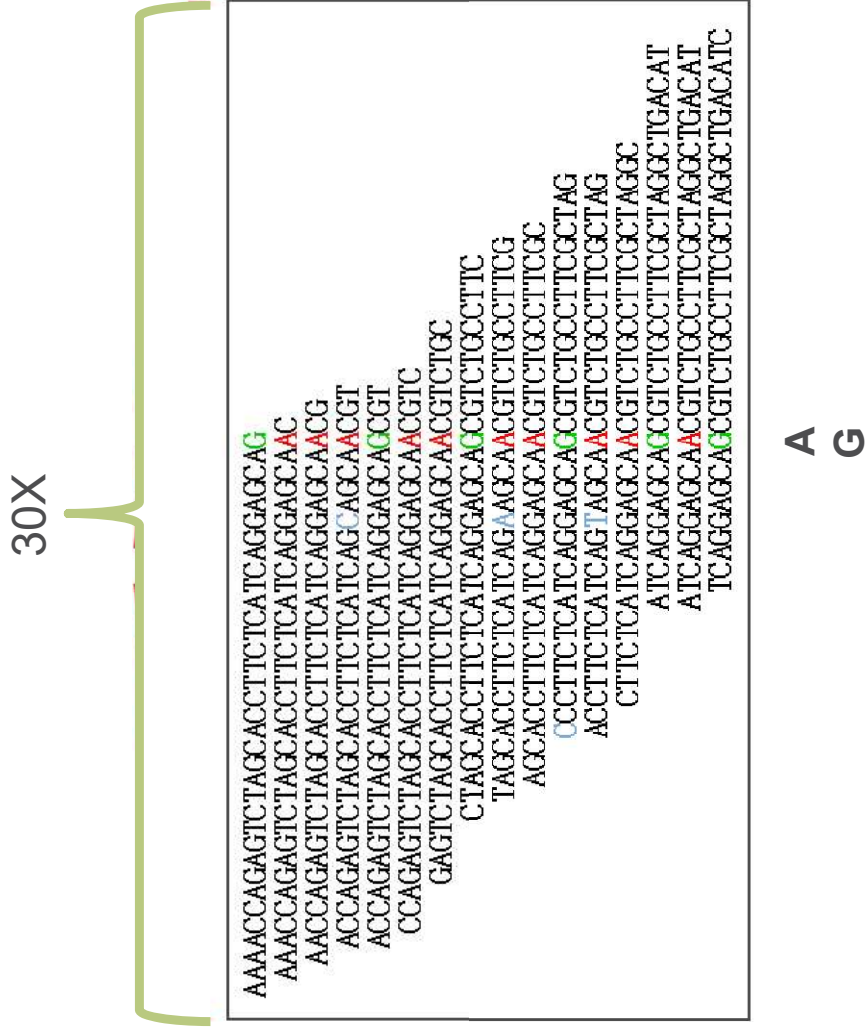
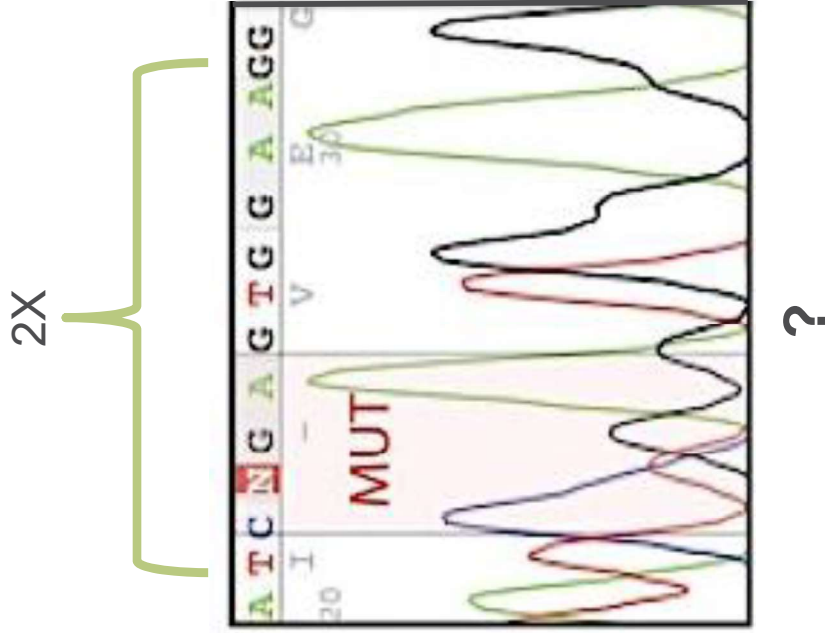
Analog

LOD 10-20% due to limited coverage

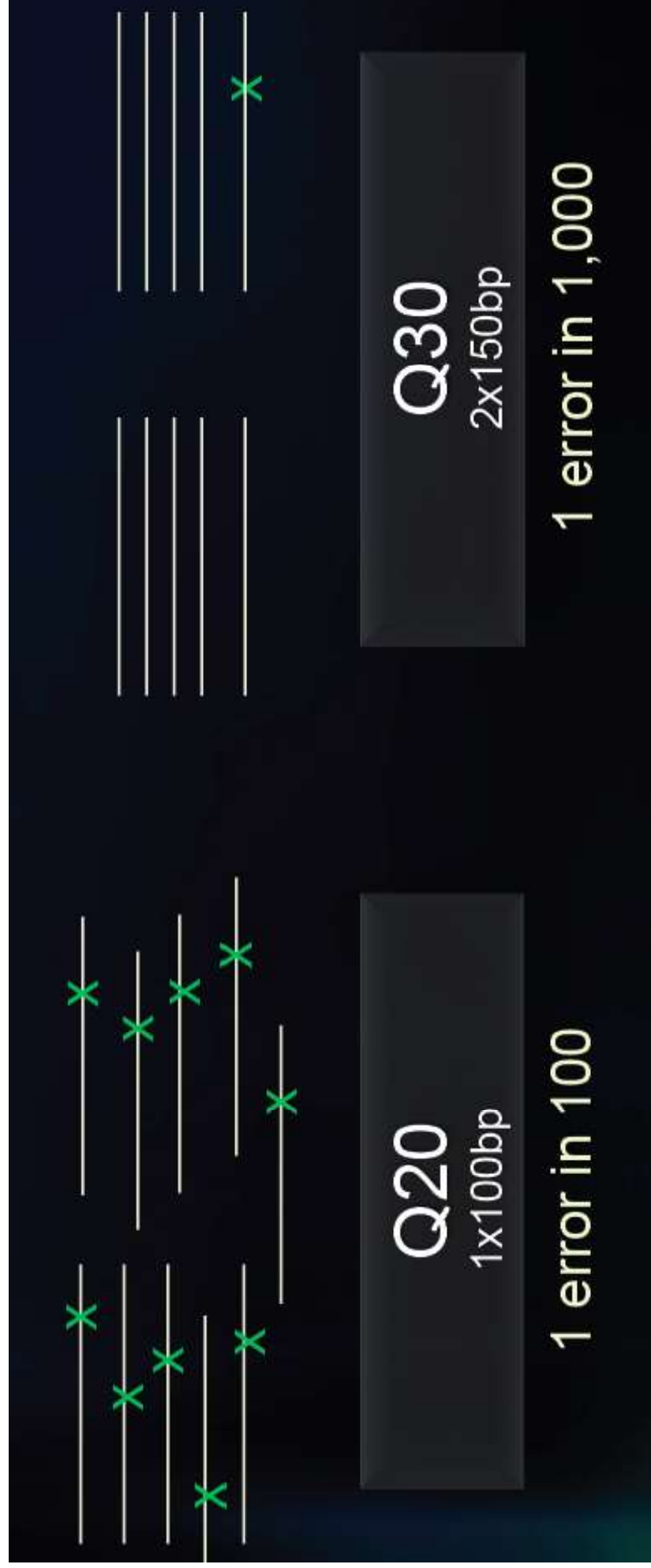


Sanger : Illumina NGS

Error or Variant?

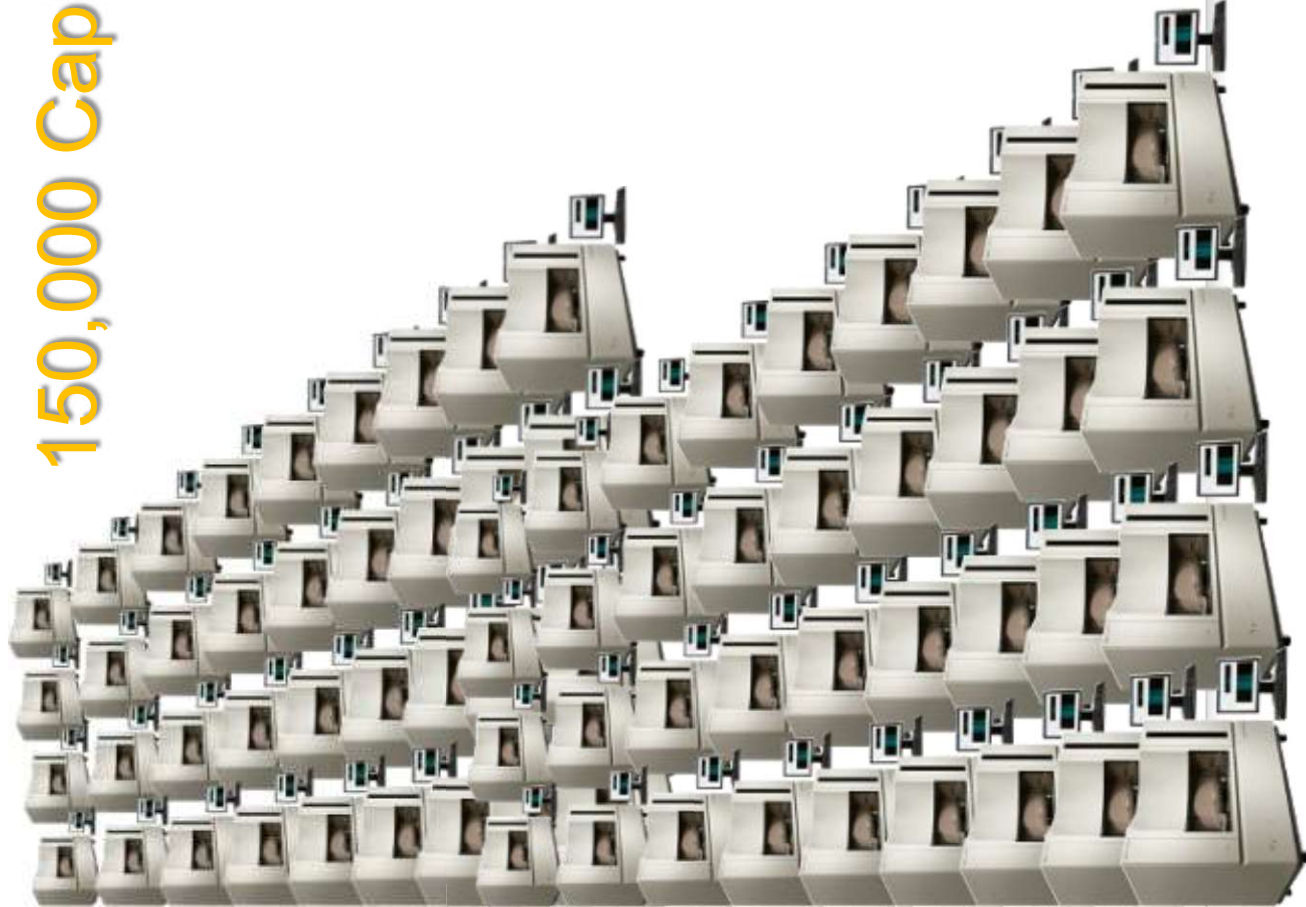


Error Rates Comparison - NGS



Scale: How much data would you like?

150,000 Capillary Sequencers

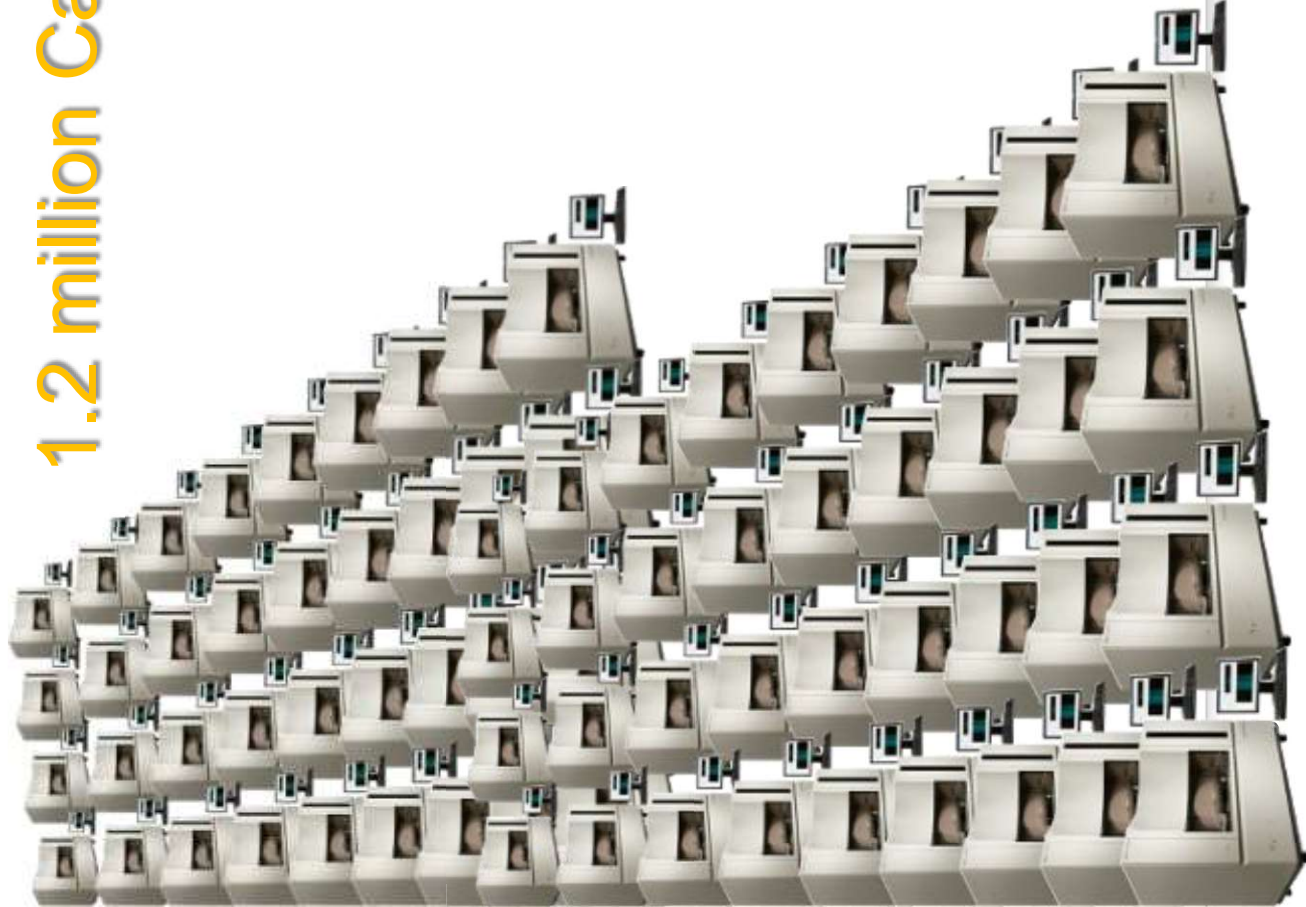


15 Gb/run

1 MiSeq

Scale: How much data would you like?

1.2 million Capillary Sequencers

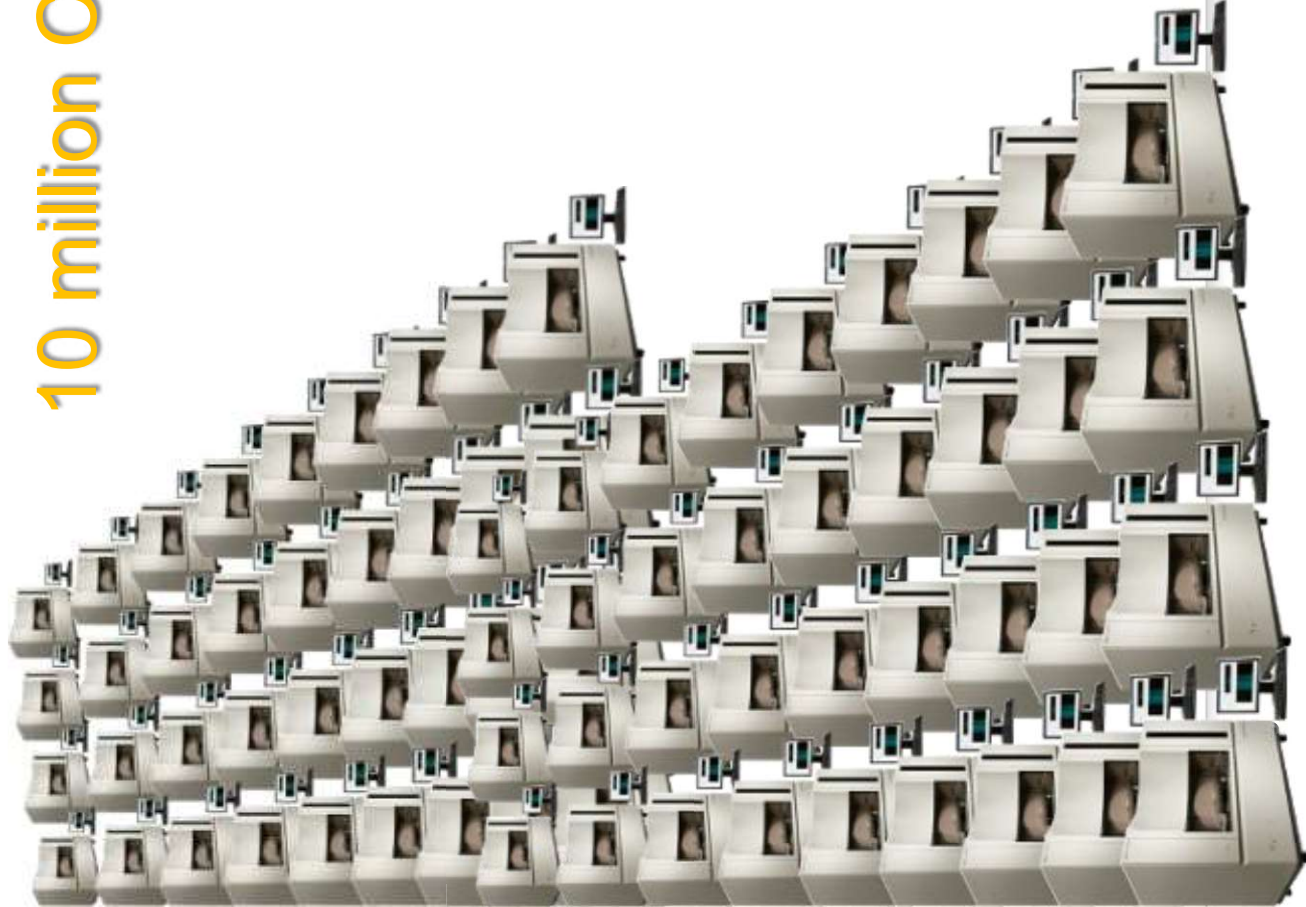


120 Gb/run

1 NextSeq

Scale: How much data would you like?

10 million Capillary Sequencers



1000 Gb/run

1 HiSeq 2500

Rapid cost reduction for sequencing

