



Industrial Hygiene in the *Genomics* Revolution

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ILLUMINA Background

About Illumina

Illumina is a leading developer, manufacturer, and marketer of life science tools and integrated systems for large-scale analysis of genetic variation and function.

Next Generation Sequencing (NGS)

Illumina's NGS technology has revolutionized the study of genomics



Illumina Background

Driving Innovation

Our initial products enabled researchers to explore DNA at an entirely new scale, helping them create the first map of gene variations associated with health, disease, and drug response.



Finding Answers

While the rate of progress is accelerating exponentially, we are only beginning to understand the clinical significance of the genome.

- *What causes a cancer cell to mutate?*
- *What is the origin of a puzzling disease?*
- *Is it possible to prevent the next outbreak?*
- *Or safeguard the world's food supply?*

These are just a few of the challenges that inspire us to push the boundaries of our imagination.

Illumina Background

COMPANY

FOUNDED Fall, 1998

IPO July 27, 2000

EMPLOYEES >4,000

HEADQUARTERS San Diego, CA

OFFICES GLOBALLY 20

FINANCIALS

\$1.86B
2014 Revenue

31%
Growth YOY

AWARDS

SMARTEST COMPANY

2014 MIT Technology Review



10 BREAKTHROUGH TECHNOLOGIES

2013 MIT Technology Review



12 MOST DISRUPTIVE NAMES IN BUSINESS

2013 Forbes



TOP 10 INNOVATIONS

2012 The Scientist Magazine



FASTEST GROWING TECH COMPANIES

2010 Forbes



Global Organization



Our Vision

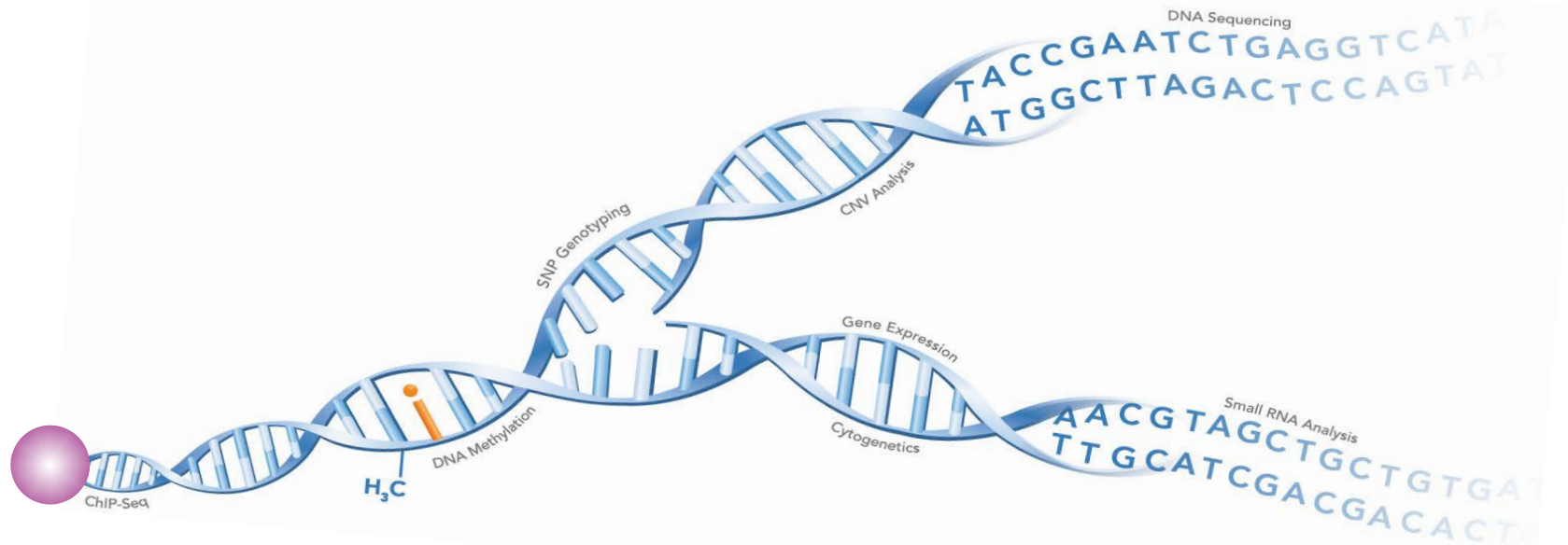
To improve human health by unlocking the power of the genome



illumina®



Understanding Genomics



Genomics seeks to **understand** the structure, function, evolution, and mapping of genomes (our DNA)

The **Human Genome Project** brought worldwide attention to genomics

Genomics has the potential to provide more **effective diagnosis**, more **precise treatments**, and more **cost-effective health care**

Cost Per Genome

\$3,000,000,000

2003 Human Genome Project



\$20,000,000

2006 1st individual genome



\$2,000,000

2007 1st NGS Genome



\$200,000

2008 1st 30x genome



\$10,000

2010 1st sub-10K genome

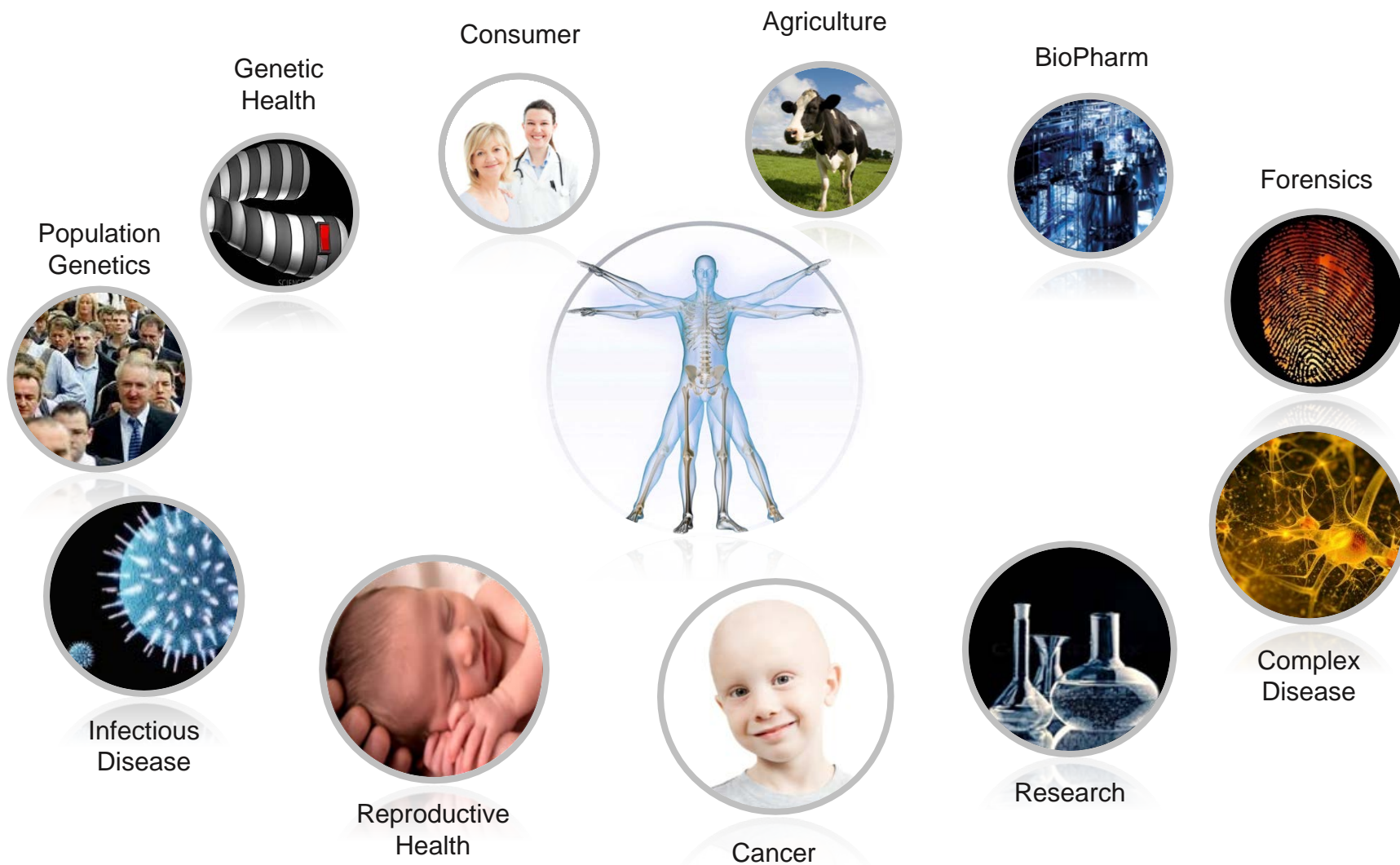


\$1,000

2014 1st \$1,000 genome



Our Markets



illumina Customers

GOVERNMENT

- ▶ Cancer Research UK
- ▶ Cold Spring Harbor Laboratory
- ▶ Genome Quebec
- ▶ JGI
- ▶ Rikeh
- ▶ Tgen
- ▶ USDA

BIOTECHNOLOGY

- ▶ Geneseek
- ▶ Hudson Alpha
- ▶ Monsanto
- ▶ Novartis
- ▶ Pioneer

ACADEMICS

- ▶ Baylor College of Medicine
- ▶ DKFZ
- ▶ Johns Hopkins
- ▶ The University of Queensland, Australia
- ▶ University of Washington

HEALTHCARE

- ▶ Children's Mercy Kansas City
- ▶ Kaiser Permanente
- ▶ Mayo Clinic
- ▶ MD Anderson
- ▶ Memorial Sloan Kettering
- ▶ Peter Mac

Health Safety & Environment (HSE) at Illumina

- ▶ Split up between 3 regions; AMR, EMEA, and APAC
- ▶ Currently growing HSE Team globally to keep up with Illumina's fast growth
 - 17 full time HSE professionals
 - 9 contracted HSE professionals



Global Health Safety and Environment

My Team at Illumina

- ▶ Global Sr. Manager of Industrial Hygiene and Chemical Compliance
 - *Anticipation, recognition, evaluation, communication and control of environmental stressors such as:*
 - Biological
 - Radiological
 - Chemical
 - Ergonomic
 - Chemical Lifecycle Management
 - SDS Authoring/RTK SDS
 - Global Chemical Registration
 - Chemical Inventory



What are some recent challenges for HSE?



Movement to Higher Risk Environments

- Growing number of customers in BSL3 and BSL4 Labs
- Application of our technology



Public Health
Agency of Canada

Agence de la santé
publique du Canada

USAID, Broad Institute
and Illumina Form a
Public-Private
Partnership Combating
the Ebola Epidemic in
West Africa



Movement to Higher Risk Environments

Our Approach...



Educate and engage
our leaders



Partner with
customers –
understand their risk



Develop Risk Management Programs

- Pre-Sale Biosafety Questionnaire
- Instrument Decontamination - using enterprise systems
- Improved Training for Field Staff

Population-Scale Sequencing



U.K.

Genomics England
100K genome project



The Scottish Genome Partnership: £15 million project



White House calls
for new era of precision medicine



Population-Scale Sequencing

Our Approach...



Move fast



Plan for growth in risk



Risk management
HSE building design guidelines



Collaborate with stakeholders

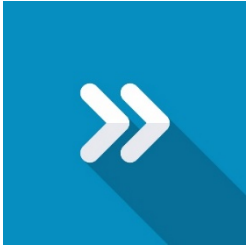
Acquisitions and Partnerships

- *New people and new technology*



Acquisitions and Partnerships

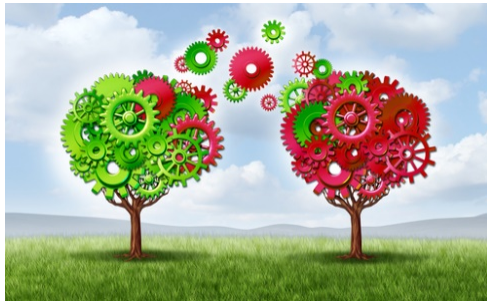
Our Approach...



Move fast



**Quick integration of
HSE culture**



**HSE risk assessment
and technology transfer**



Collaborate with stakeholders

Product Development Speed

POPULATION POWER



HiSeq X™
Ten



HiSeq X Five

PRODUCTION POWER



HiSeq® 4000



HiSeq 3000



HiSeq 2500

FLEXIBLE POWER



NextSeq™ 500/550

FOCUSED POWER



MiSeq®



MiSeqDx™



MiSeqFGx™

ARRAY SCANNERS | BeadArray, Infinium, GoldenGate, DASL

POWERFUL ARRAY SCANNER



HiScan®

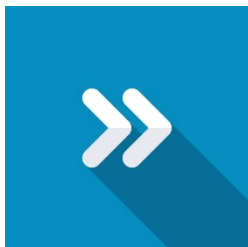
CUTTING-EDGE ARRAY SCANNER



iScan

Product Development Speed

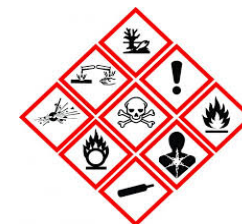
Our Approach...



Move fast



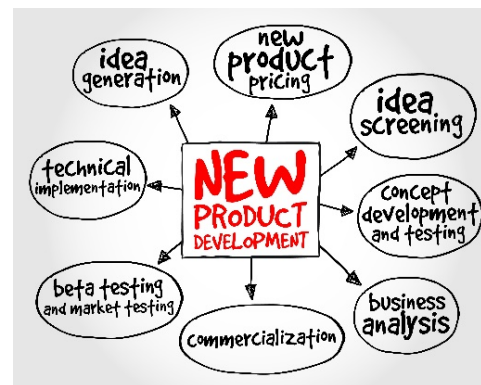
Collaborate with stakeholders



Chemical Lifecycle
Management



HSE risk assessment



Integrate HSE in product development

Research to Clinical Applications



U.S. Food and Drug Administration
Protecting and Promoting *Your* Health



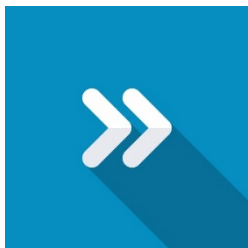
China Food and Drug Administration

- ▶ Clinical Labs to begin to adopt next-generation sequencing (NGS) among the standard methods used to identify pathogens and diagnose disease
- ▶ Many obstacles in the way to clinical for NGS including
 - automation, standardizing technical protocols and bioinformatics pipelines, improving reference databases, establishing proficiency testing and quality control measures, and reducing cost and turnaround time
- ▶ Only one FDA-cleared NGS instrument—the MiSeqDx by Illumina
- ▶ Two FDA-cleared assays—Illumina’s own cystic fibrosis assays that run on the MiSeqDx.



Research to Clinical Applications

Our Approach...



Move fast



Collaborate



**HSE part of Illumina clinical
transformation**



Build team and skillset



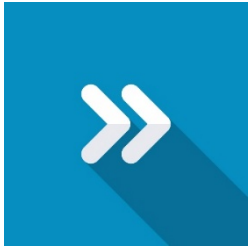
Robust documentation

Company Facility and People Growth



Company Facility and People Growth

Our Approach...



Move fast



Sustainability



**HSE building design
guidelines**



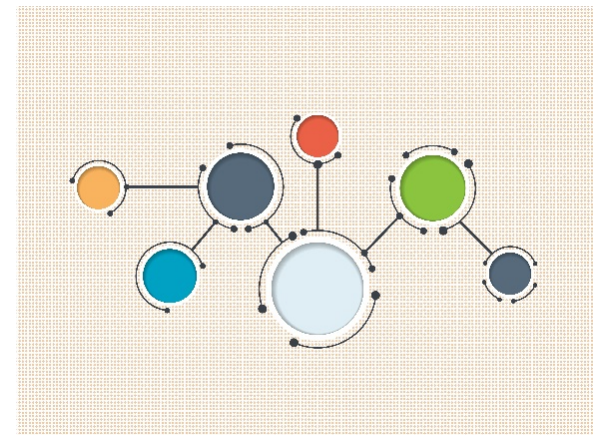
Maintain HSE culture



Collaborate

Integrating Industrial Hygiene into Business

- ▶ Present risk-based opportunities to the HSE Steering Committee
 - Address the Severity and Likelihood
- ▶ Integrate IH needs into the HSE Strategic Plan
 - Injury and Illness Prevention
 - Regulatory Compliance and Business Impact
 - Best Practice/Gold Standard
- ▶ Emphasize global in your characterization of risk – leverage global team
- ▶ *Attend company-sponsored career panels!*



Industrial Hygiene *Looking Forward*

- ▶ Ergonomics
 - Self-assessment tool for office ergonomics
- ▶ Laser Safety
 - LSO Development - 22 LSOs
- ▶ Biological Safety
- ▶ Risk Assessment (qualitative and quantitative)
 - Leverage hazard data from SDS!
 - Exposure assessment strategy
- ▶ Lab Health and Safety
 - Fundamental responsibilities within industrial hygiene (anticipation, recognition, evaluation, and control) are used



Thank you

“...the sequence of the human DNA is the reality of the species, and everything that happens in the world depends upon those sequences.”

-Renato Dulbecco, Nobel Laureate

