生物晶片在癌症醫學檢驗上的應用

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生物晶片的應用

- **應用：**致病基因探尋、基因調控、蛋白質功能研究 、新藥開發、法學檢定、軍事偵防等及單一核甘酸多型性(SNP, single nucleotide polymorphism)等 。
- **新藥開發：**找到人體生病細胞上的蛋白質，再開發有效的藥物，以提升新藥開發速度。
- **疾病臨床檢驗：**應用在病人檢體之細菌、病毒、寄生疾病的檢驗。
- **醫療診斷：**病人檢體中萃取核酸，再將目標核酸放大(Amplification)、雜交進而獲得結果
- **親子鑑定：**因此利用生物晶片可作DNA順序(Sequence)檢定
- **環境與食品檢驗：**檢測食物是否受到某種微生物或毒物污染。

生物晶片的優點

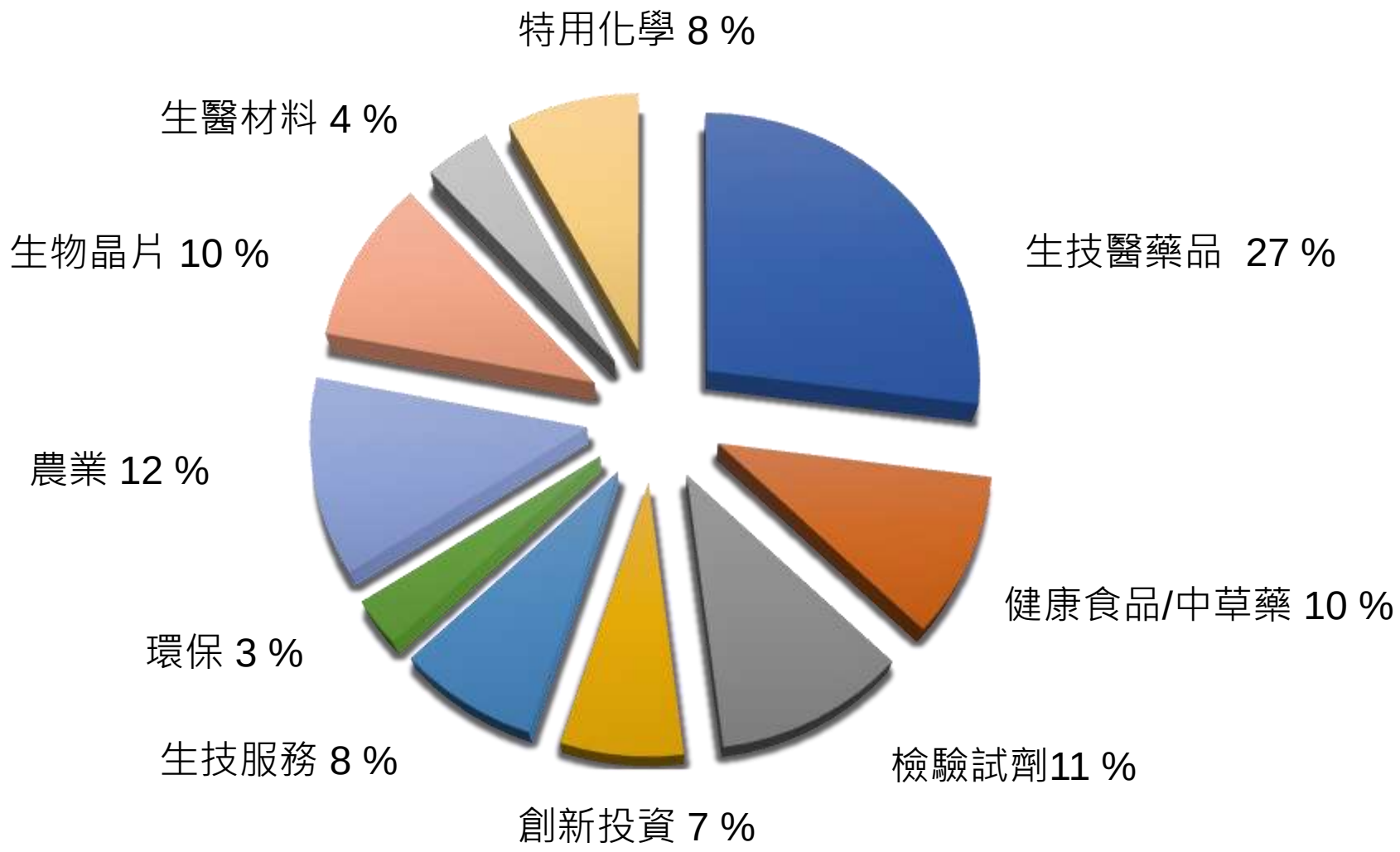
- 所需的樣本量極微小
- 分離與分析的操作平行化
- 儀器技術的整合
- 降低製造成本
- 減少試劑用量
- 減低操作成本
- 縮短檢測時間
- 可攜帶

缺少上述優點的生物晶片將失去市場競爭力

生物晶片應用領域

生物晶片產業市場2001-2020 應用領域 市場預估值 (百萬美元)						
應用領域	2001	2002	2005	2010	2015	2020
Biomedical/Gene Research	801	1118	3081	6820	14560	20090
Disease Treatment/Management	27	52	234	1430	3640	6650
Pharmacogenomics	9	13	78	660	1820	3690
Diagnostics/Testing	54	104	390	1760	4420	8200
Agricultural Biotechnology	0	0	39	110	260	410
Environmental Industries	9	13	39	220	520	820
Forensics & Military	0	0	39	110	520	410
Others	0	0	0	0	260	410
Total	900	1300	3900	11110	26000	40680
Source: Helmut Kaiser Consultancy						

台灣生技產業



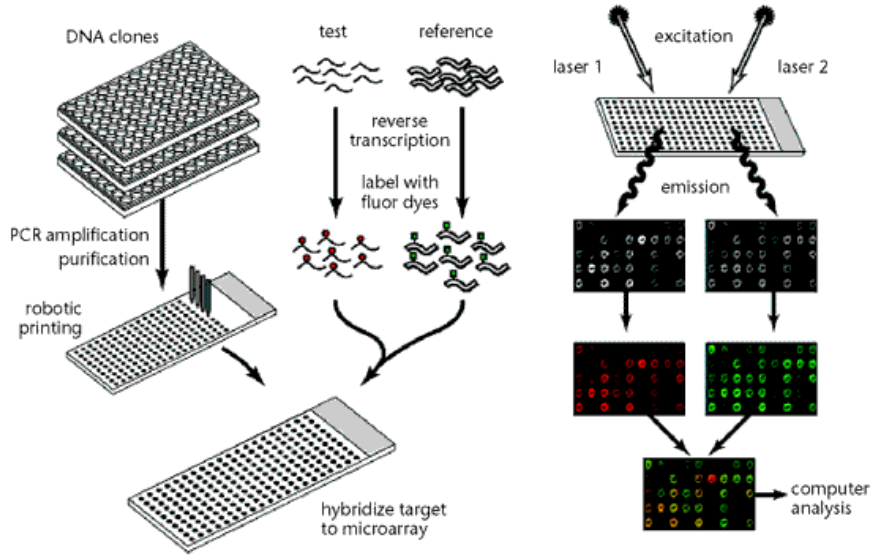
2015經濟部生技醫藥產業推動小組

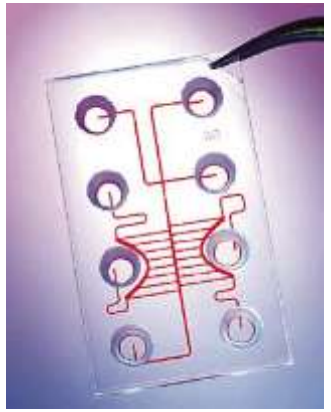
生物晶片的演進

物理性雜交

化學性反應

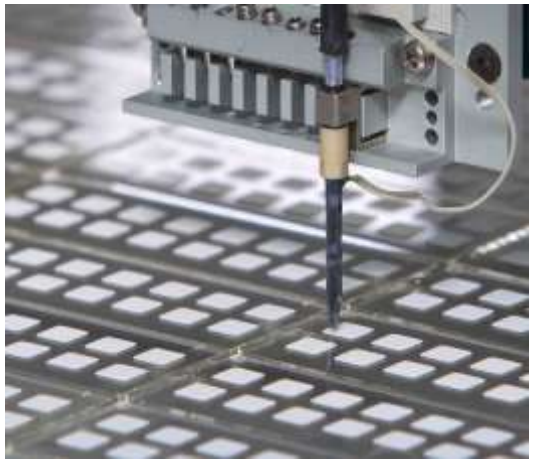
系統性實驗過程

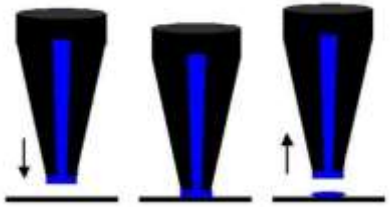


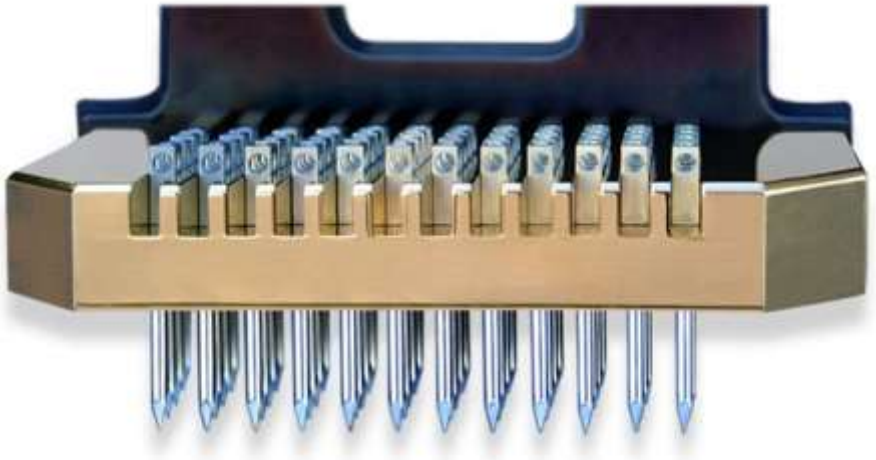


Lab on chip

狹義的生物晶片
微陣列晶片如何運作







以偵測RNA為基礎的Microarray

想了解基因表現量的差異

cDNA array

以偵測DNA為基礎的Microarray

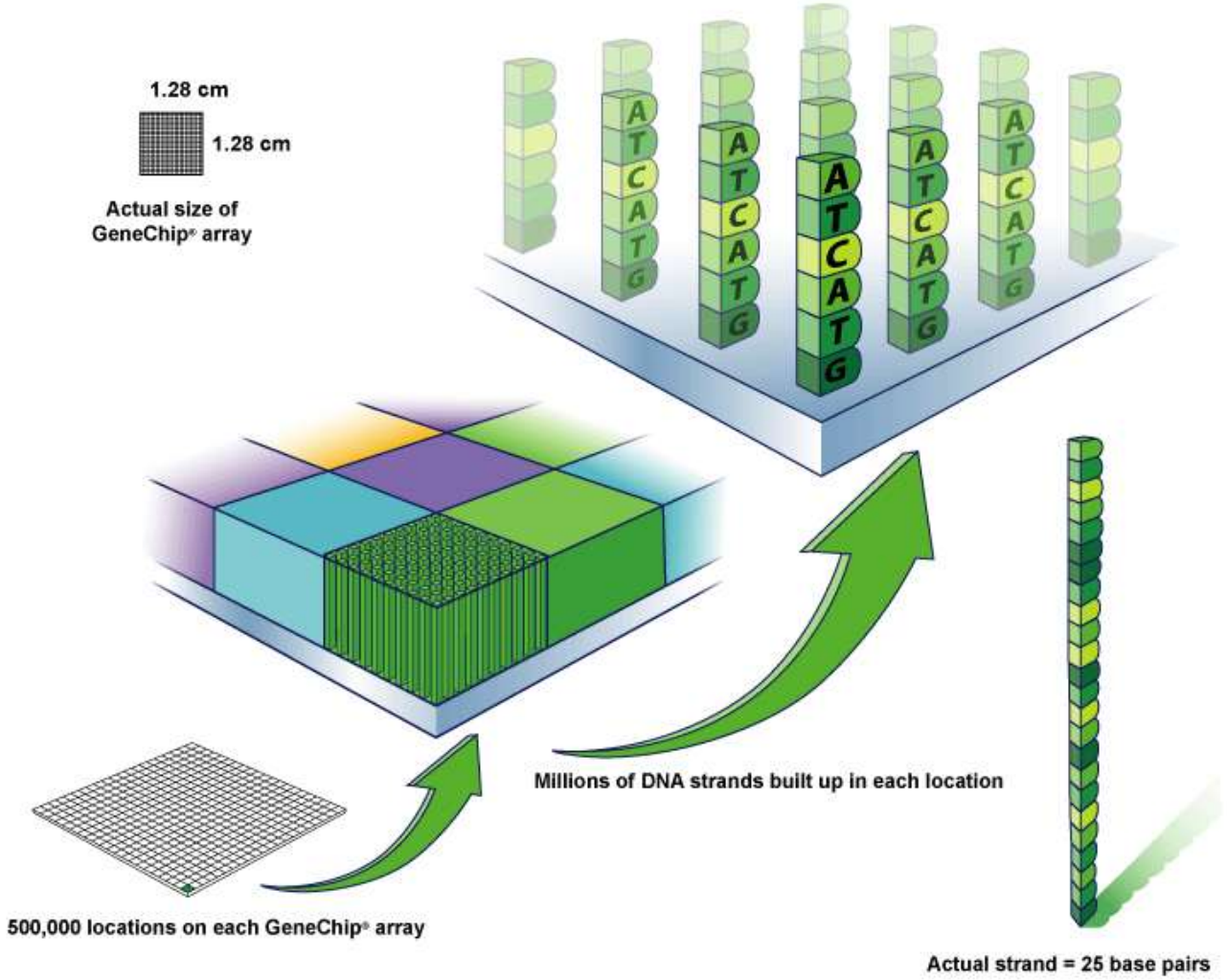
想了解單一核甘酸多型性差異

SNP array

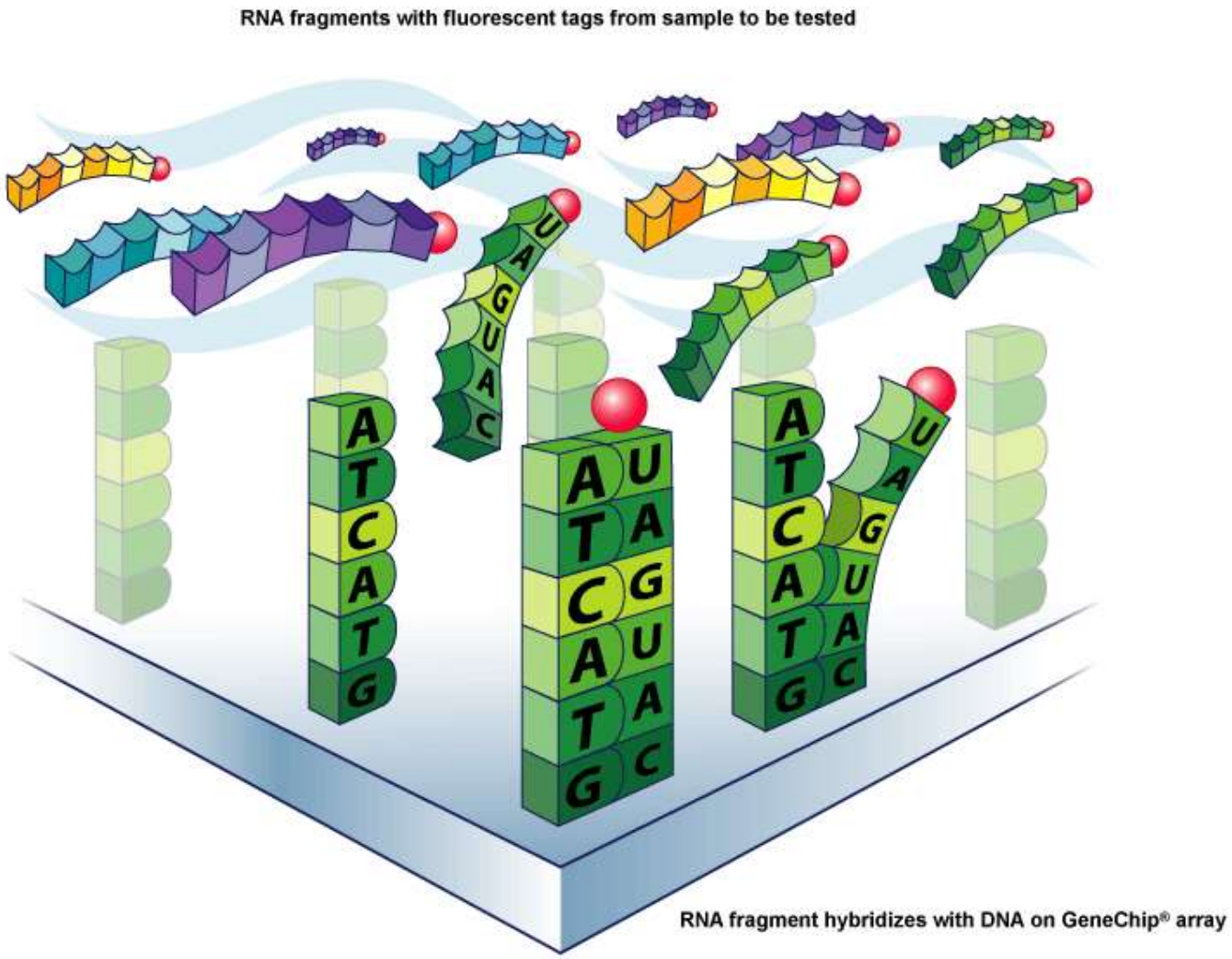
想了解染色體拷貝數差異

aCGH (array Comparative Genomic Hybridization)

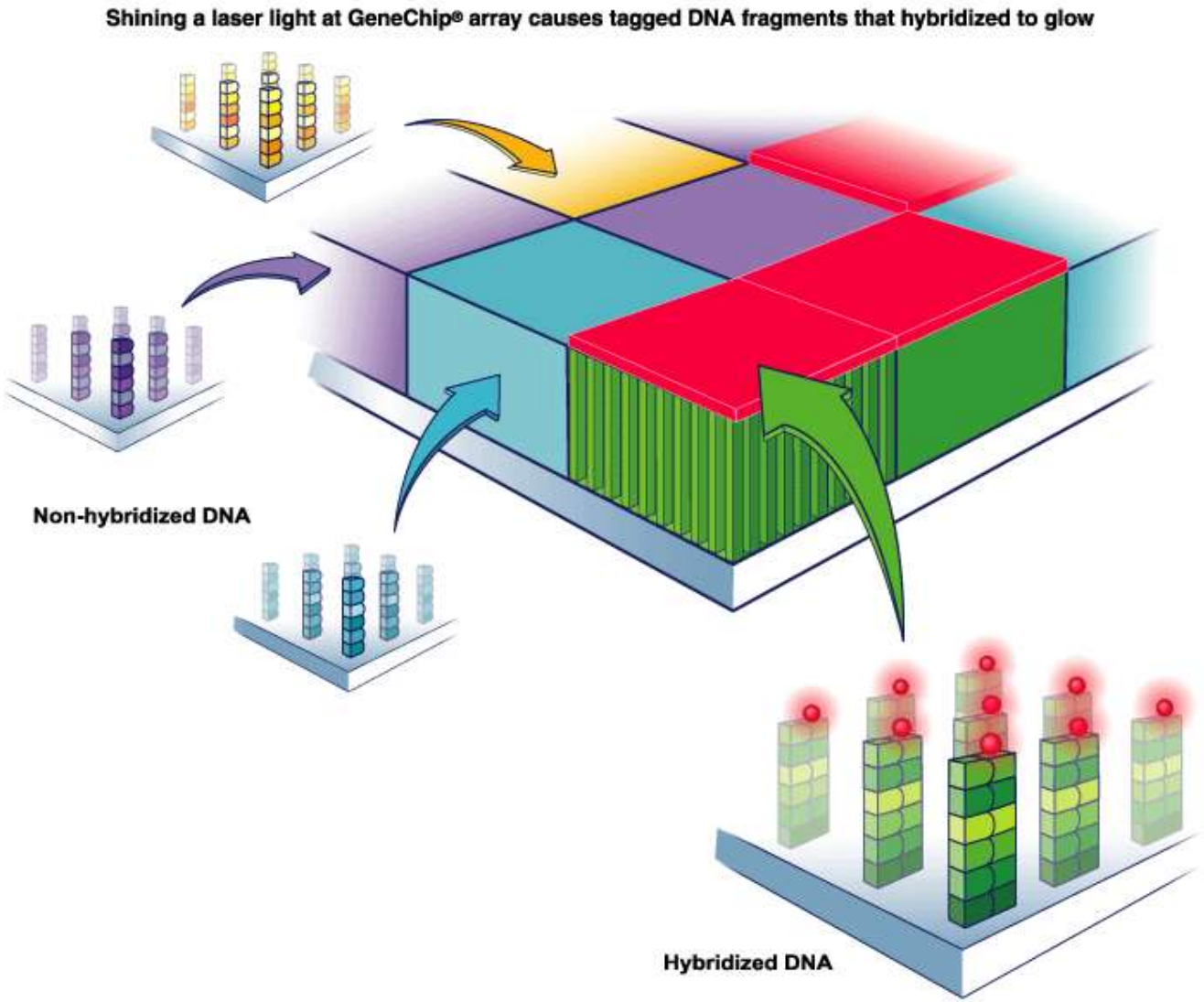
cDNA微陣列晶片構造



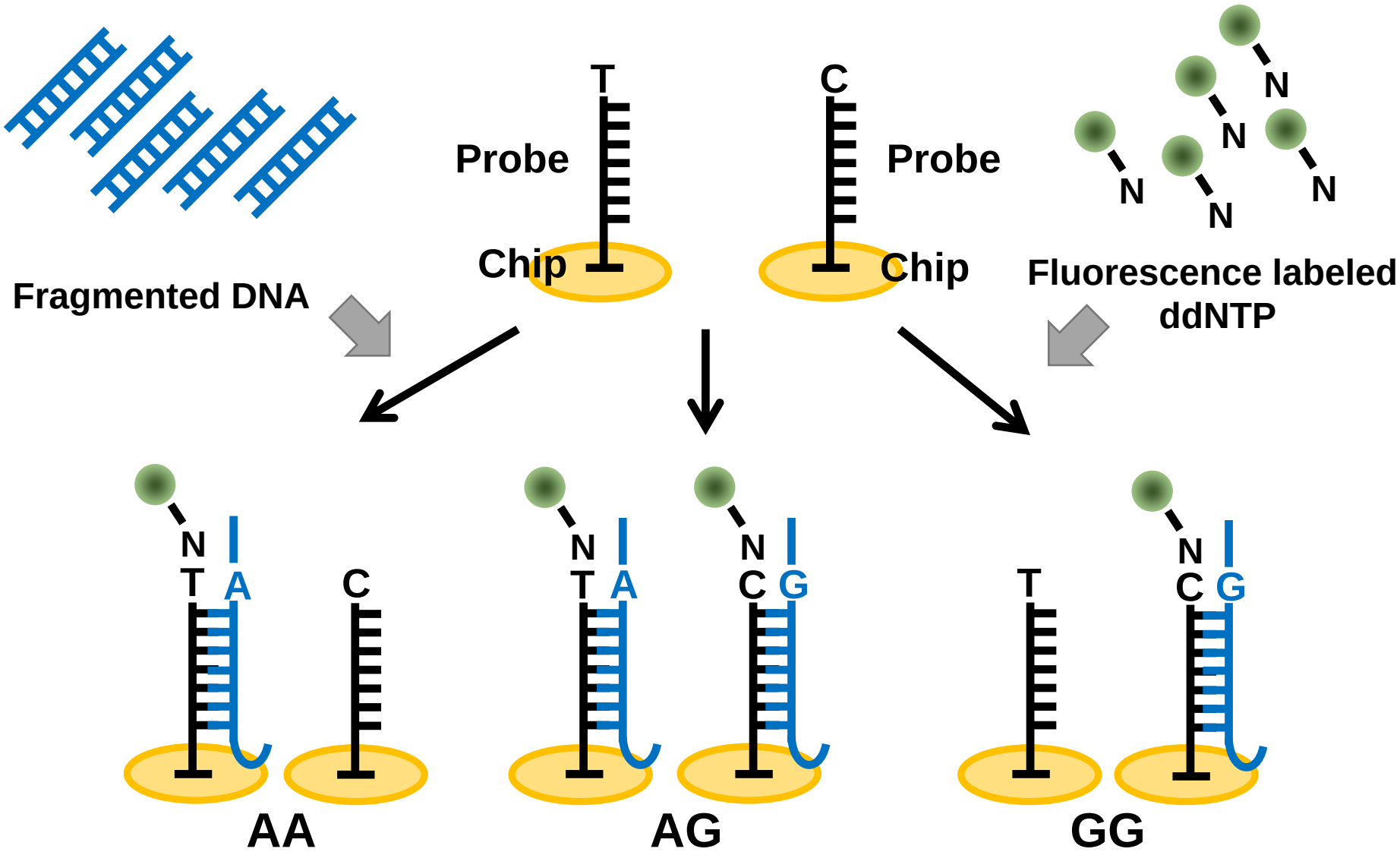
cDNA微陣列晶片運作



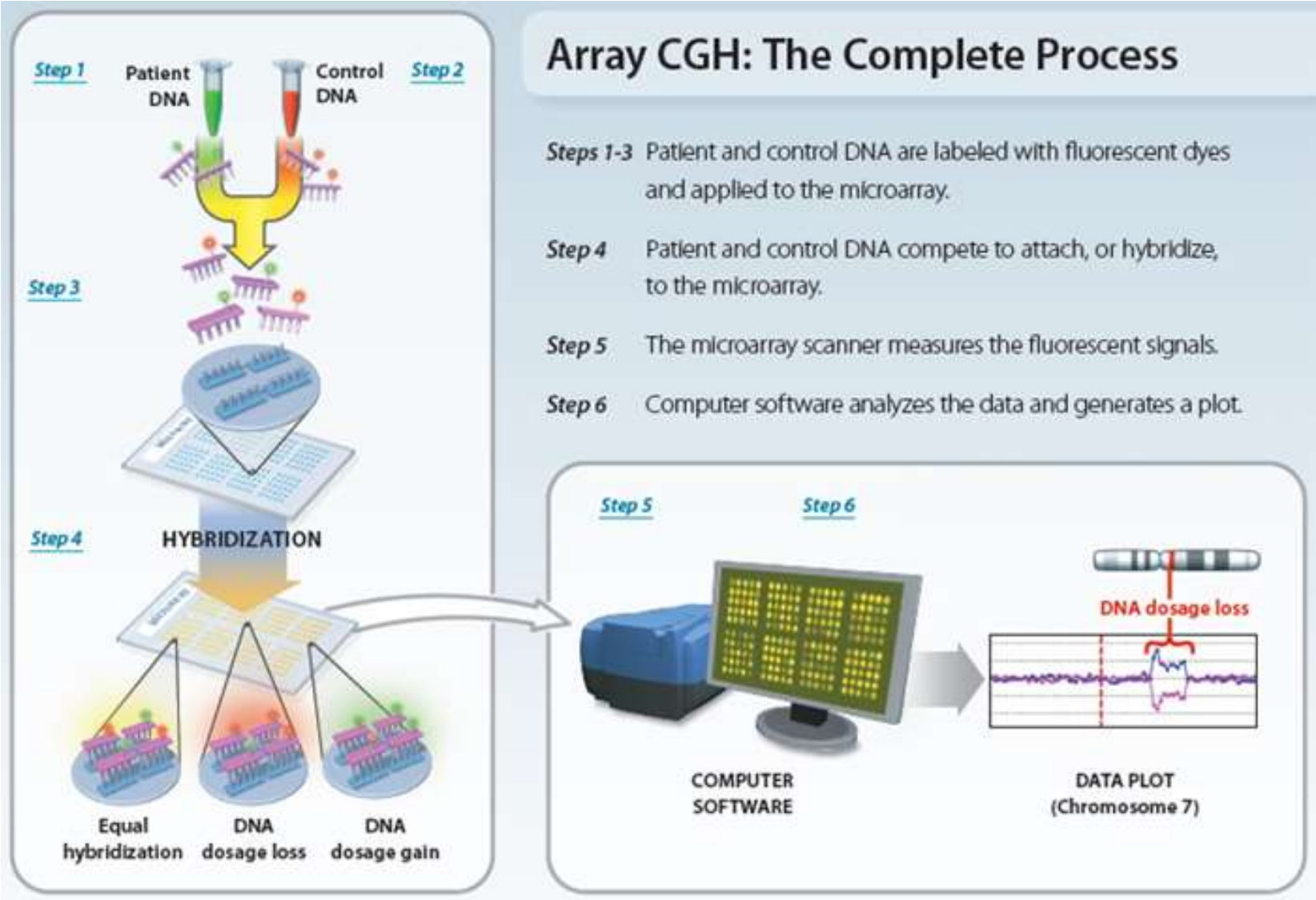
cDNA微陣列晶片偵測



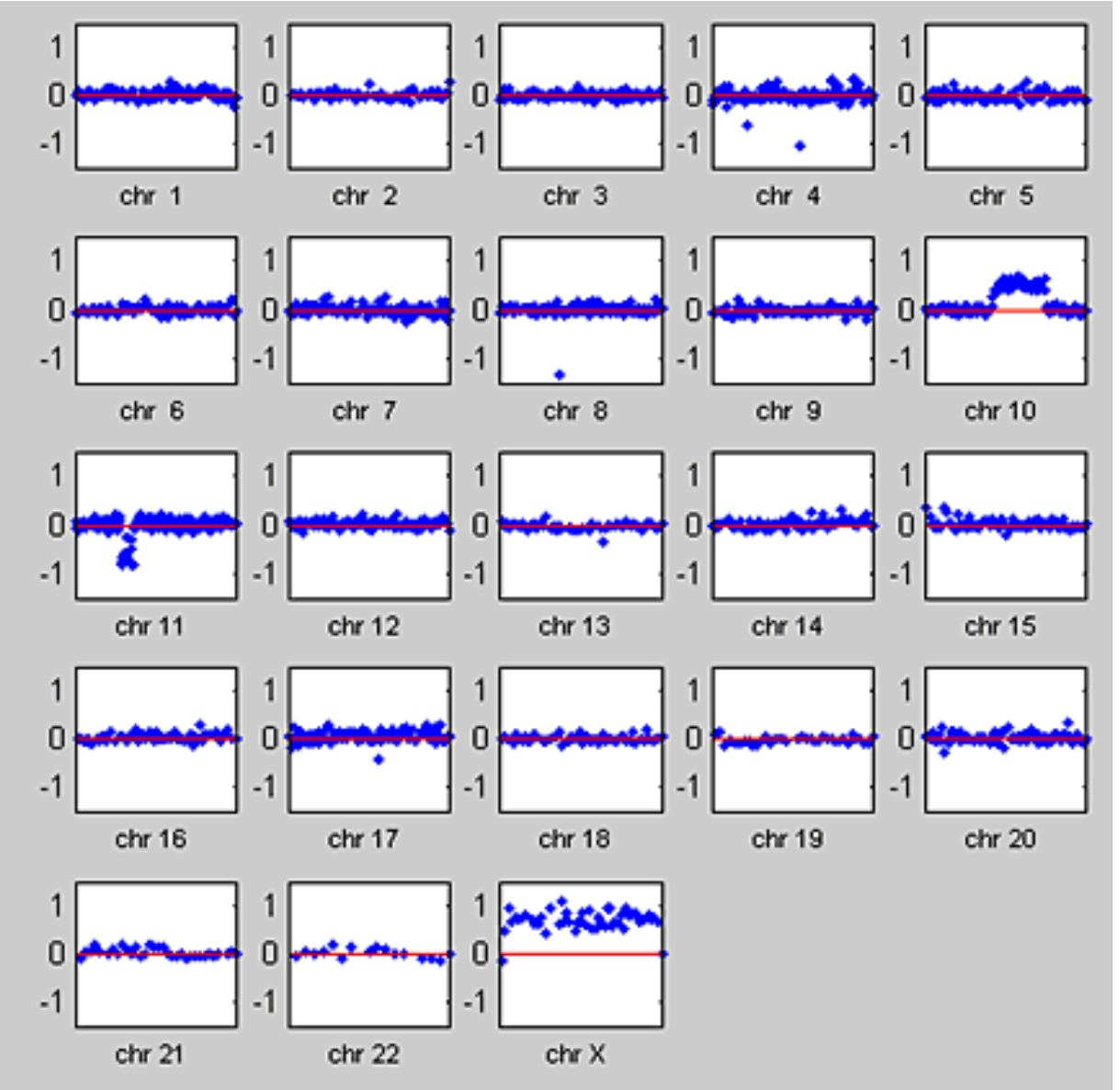
SNP 微陣列晶片原理


Fragmented DNA
Probe
T
Chip
Probe
C
Chip
N
N
N
N
N
Fluorescence labeled
ddNTP
N
T
A
C
AA
N
T
A
N
C
G
AG
T
N
C
G
GG

aCGH實驗流程


Step 1
Patient DNA
Control DNA
Step 2
Step 3
Step 4
HYBRIDIZATION
Equal hybridization
DNA dosage loss
DNA dosage gain
Array CGH: The Complete Process
Steps 1-3 Patient and control DNA are labeled with fluorescent dyes and applied to the microarray.
Step 4 Patient and control DNA compete to attach, or hybridize, to the microarray.
Step 5 The microarray scanner measures the fluorescent signals.
Step 6 Computer software analyzes the data and generates a plot.
Step 5
Step 6
DNA dosage loss
COMPUTER SOFTWARE
DATA PLOT (Chromosome 7)

aCGH 結果判讀


1
0
-1
chr 1
chr 2
chr 3
chr 4
chr 5
chr 6
chr 7
chr 8
chr 9
chr 10
chr 11
chr 12
chr 13
chr 14
chr 15
chr 16
chr 17
chr 18
chr 19
chr 20
chr 21
chr 22
chr X

aCGH應用

蘋果副刊 › 高齡產婦 10年增5倍 抽羊水驗基因 防生缺陷兒

高齡產婦 10年增5倍 抽羊水驗基因 防生缺陷兒

2009年03月23日 0 0 更多專題文章

34歲以上被算高齡產婦，胎兒發生染色體異常的機率較高，跨界平場

【醫療組／台北報導】高齡產婦佔全體產婦比例愈來愈高，根據台大醫院和長庚醫院婦產部統計，門診中1/4的產檢孕婦超過34歲，相較於10年前34歲後生產的人，現在人數是10年前的5倍。台大醫院基因醫學部暨婦產部醫師蔡怡寧表示，羊膜穿刺除了做胎兒健康檢查，台大醫院更提供胎兒基因晶片檢查，羊膜穿刺染色體檢查時多抽10c.c.羊水，可偵測近200種基因微小缺陷造成的罕見疾病。

與羊膜穿刺並行

孕婦年齡愈大，胎兒發生染色體異常的先天性疾病風險愈高。國民健康局針對34歲以上高齡產婦，經醫師諮詢討論後屬於生下染色體異常寶寶的高危險群，建議懷孕16至20周時做羊膜穿刺染色體檢查，政府補助2000元，另需自費約6000至8000元，篩檢的重點在於發生率最高的唐氏症，但是無法檢查出染色體的微小片段缺失，包括小胖威力症候群、威廉氏症候群等罕見疾病，需做進一步基因晶片檢查，合計約需自費2萬5000元。蔡怡寧醫師指出，台大醫院半年多來已有150名孕婦做胎兒基因晶片檢查，高齡產婦佔7成。馬偕醫院婦產科醫師江盛凱，檢查後醫

YAHOO! 奇摩

懷孕前需做檢查　可做遺傳諮詢與篩檢

健康網 – 2012年4月1日 上午11:30

人類的懷孕有一半的機會會自然流產，或許妳也聽說過很多醫師輕描淡寫的安慰流產婦女，阮綜合醫院生殖醫學中心李永全主任表示，小於12週的自然流產65%與染色體或基因異常有關，不過懷孕前，到底有那些項目可以先檢查先預防呢？排除先天或後天造成的解剖組織結構異常因素：考慮接受超音波，子宮輸卵管攝影，腎臟超音波檢查（有些發育異常會同時合併腎臟及子宮卵巢發育異常）。

1.免疫學篩檢：可能要檢驗狼瘡抗凝劑，抗心磷脂抗體，遺有特定醣蛋白抗體。免疫問題可以用低劑量阿斯匹靈，肝素等藥物預防。

2.容易栓塞的體質要驗：凝血 原基因突變、活化 蛋白質C阻抗、同半胱胺酸、蛋白質C、蛋白質S、抗凝血。

3.內分泌方面要注意：甲狀腺功能篩檢、糖尿病篩檢（血糖、糖化血色素），泌乳激素篩檢。調整月經黃體期時間長短。

4.排除環境汙染輻射或極端溫度影響因子，作息規律化。

李永全說首先應考慮夫妻雙方染色體檢查（建議流產3次以上的人要做），若有異常先接受基因遺傳諮詢。卵巢儲備功能篩檢（例如：濾泡刺激素及抗穆勒氏荷爾蒙之類的檢查），若是排出卵子品質不佳、年齡又在45歲以上要考慮使用別人捐贈的卵子。若是懷疑特定家族遺傳的疾病，單一基因疾病，或是「微小片段缺失症候群」，可以使用胚胎植入前基因診斷技術、晶片式全基因體定量分析技術（aCGH）。

傳統染色體 檢查 晶片分析
可偵測 99%已知的基因體微小缺失疾病

認識基因晶片

基因晶片就是將大量的DNA片段，以矩陣的方式，整齊的排列在玻璃片上，每個DNA片段，可以專一的偵測特定基因位置，這種DNA片段，我們稱之為基因探針。因此基因晶片上基因探針越多，可以偵測的位置就越多，可以看到更細微的變化。此外，基因探針的選擇也很重要，必須包括重要的致病位置，穩定度及再現性也要好，這種才能有最可靠的分析結果。

基因晶片的用途

基因體晶片技術主要用於偵測全基因體的基因增加或減少，目前更應用於胎兒的產前診斷，分析胎兒基因體是否發生基因增加或減少的變化。這項新的技術讓傳統染色體分析邁入了另外一個新的世代，協助解決傳統染色體檢查看不到的細微異常，因此我們可以將aCGH稱之為高解染色體基因體分析技術。

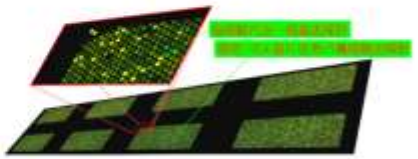
傳統的染色體檢查

大家熟知的胎兒染色體分析，主要是透過絨毛採樣或羊膜穿刺，取得胎兒的絨毛或羊水，經由細胞培養、染色後，在光學顯微鏡下觀察每個細胞的染色體數目或結構是否有異常。研究發現，隨著孕婦年齡的增加，生下染色體異常胎兒的機率也隨之提高，因此台灣的衛生機關鼓勵高齡孕婦或曾懷有染色體異常胎兒的孕婦於進行胎兒的染色體分析，像是唐氏症、透納氏症、愛德華氏症及巴陶氏症等等，都能夠準確的被檢查出來。

搭配基因晶片可以提高異常個案的檢出率

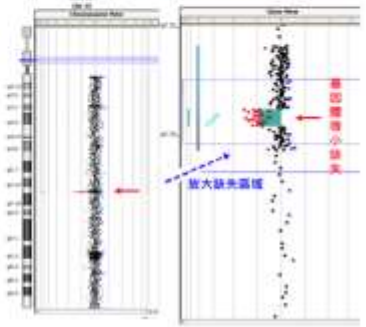
對於一些先天性異常的新生兒，包括智能障礙、發展遲緩、先天性多重異常或自閉症等等，為了確認異常的原因，除了臨床評估外，醫生也會建議進行染色體分析，近兩年國外已有專家學者建議直接用基因晶片來檢查產後的異常個案。研究顯示，排除唐氏症、透納氏症及臨床症狀明顯的患者外，以傳統染色體分析先天異常的新生兒，僅有3%可以找到致病原因，但是透過基因體晶片分析，確診率可提高至15%~20%。主要是因為基因體晶片大幅提高染色體檢查的解析度，這些致病的微小缺失或重複突變，用晶片

高密度ISCA基因晶片



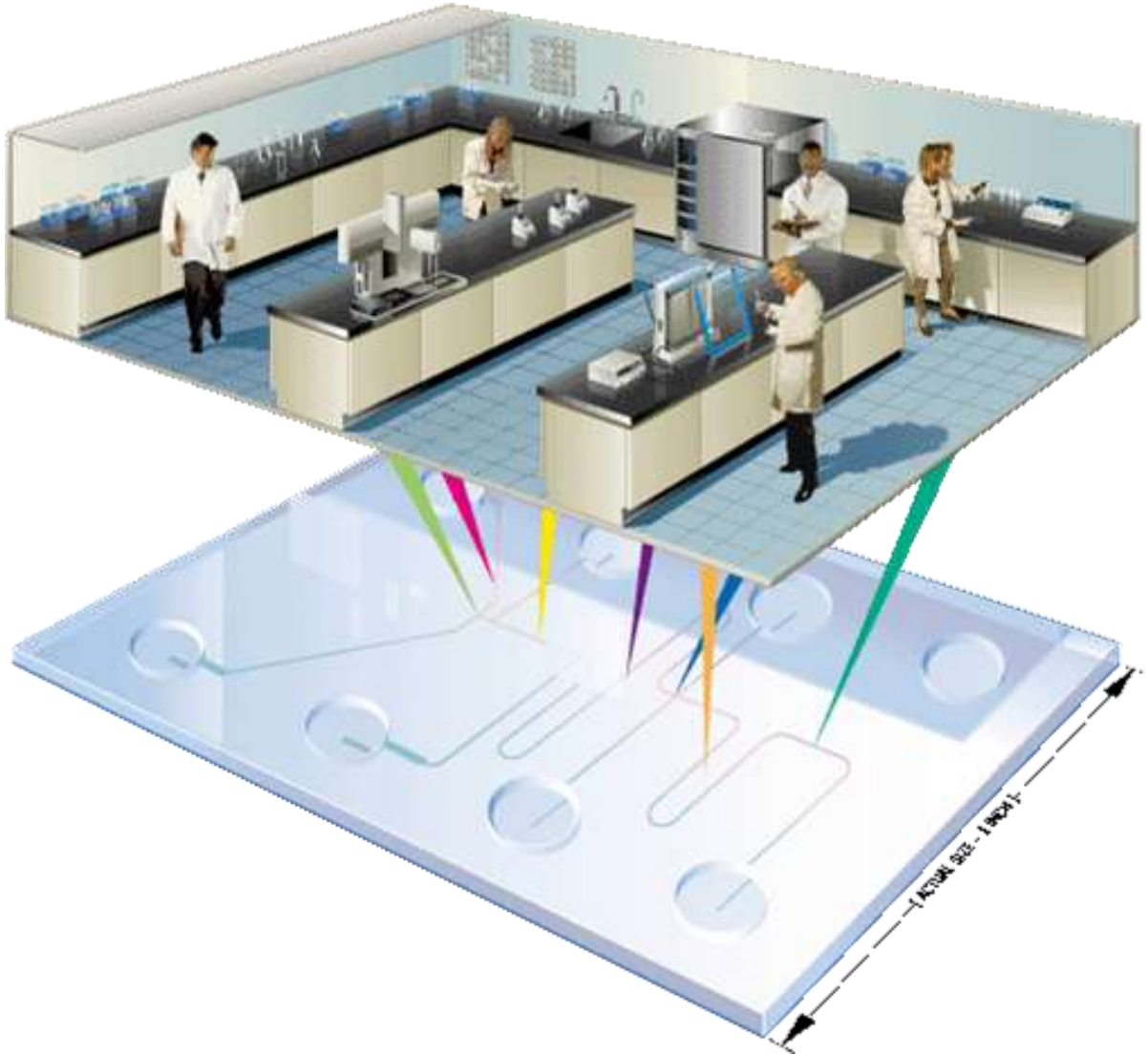
傳統染色體分析
400-550條帶解析度
（光學顯微鏡以肉眼觀察）

ISCA晶片
6萬基因探針 超高解析度10-100倍
（2um高階掃描搭配電腦分析）



廣義的生物晶片

Lab-on-a-chip



多試劑反應居家檢測晶片

nature COMMUNICATIONS

ARTICLE

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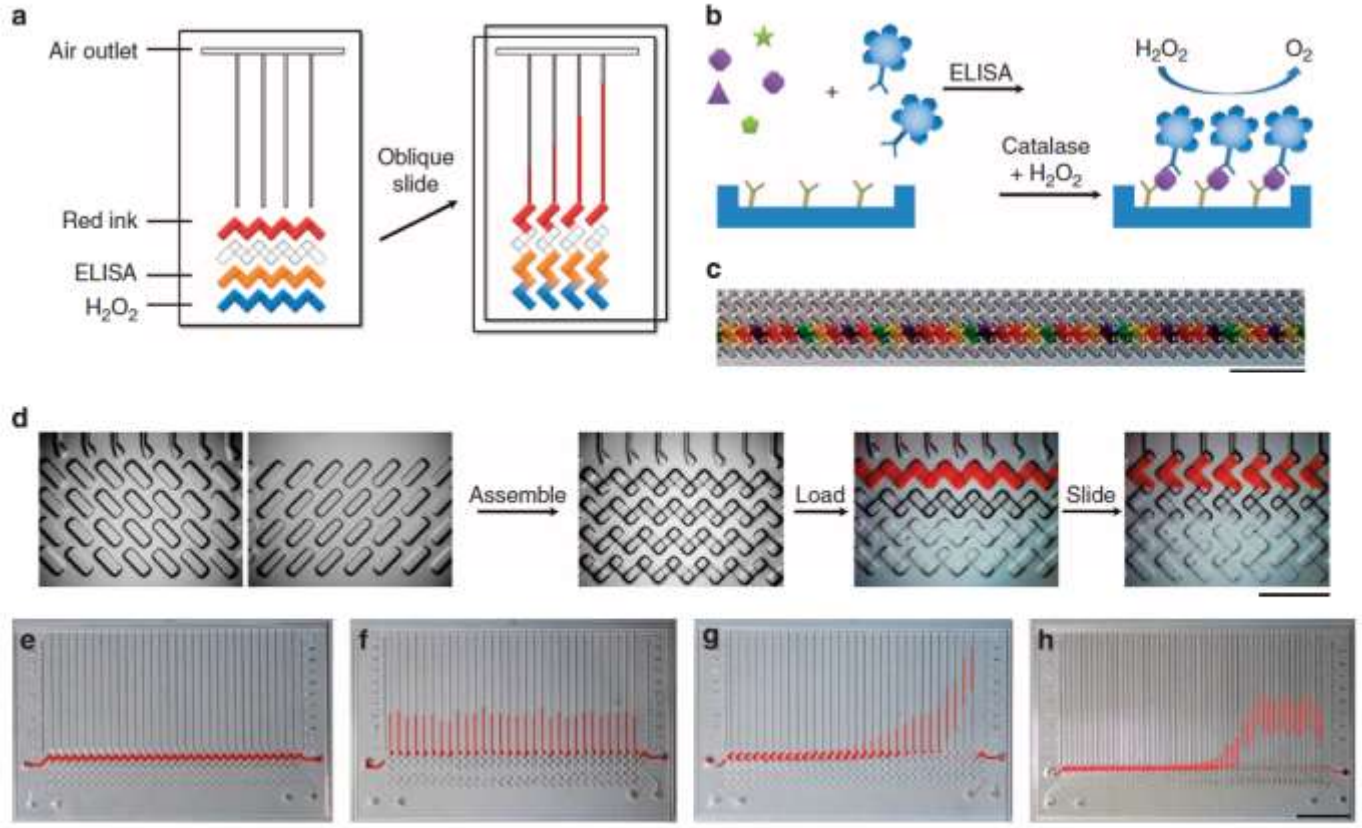
Multiplexed volumetric bar-chart chip for point-of-care diagnostics

Yujun Song[1], Yuanqing Zhang[1], Paul E. Bernard[1], James M. Reuben[2,3,4], Naoto T. Ueno[2,3], Ralph B. Arlinghaus[5], Youli Zu[6] & Lidong Qin[1]



居家聚合酶鏈鎖反應晶片

OPEN ACCESS Freely available online

PLOS one

Microfluidic Chip for Molecular Amplification of Influenza A RNA in Human Respiratory Specimens

Qingqing Cao[1☯], Madhumita Mahalanabis[2☯], Jessie Chang[2], Brendan Carey[2], Christopher Hsieh[2], Ahjegannie Stanley[2], Christine A. Odell[3], Patricia Mitchell[4], James Feldman[4], Nira R. Pollock[5], Catherine M. Klapperich[1,2*]

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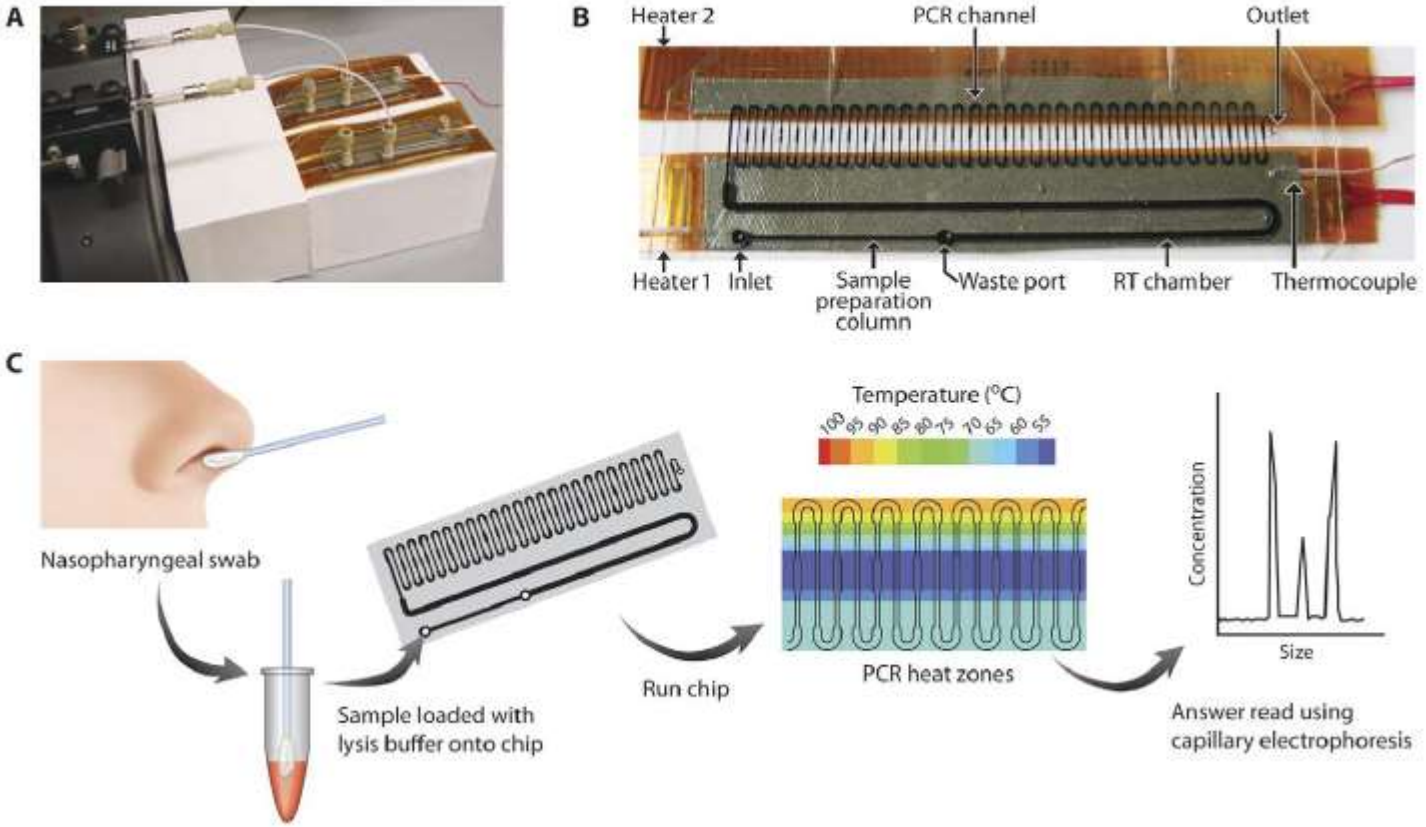

擬真活體組織培養晶片

Lab on a Chip

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Cite this: *Lab Chip*, 2012, **12**, 2165–2174

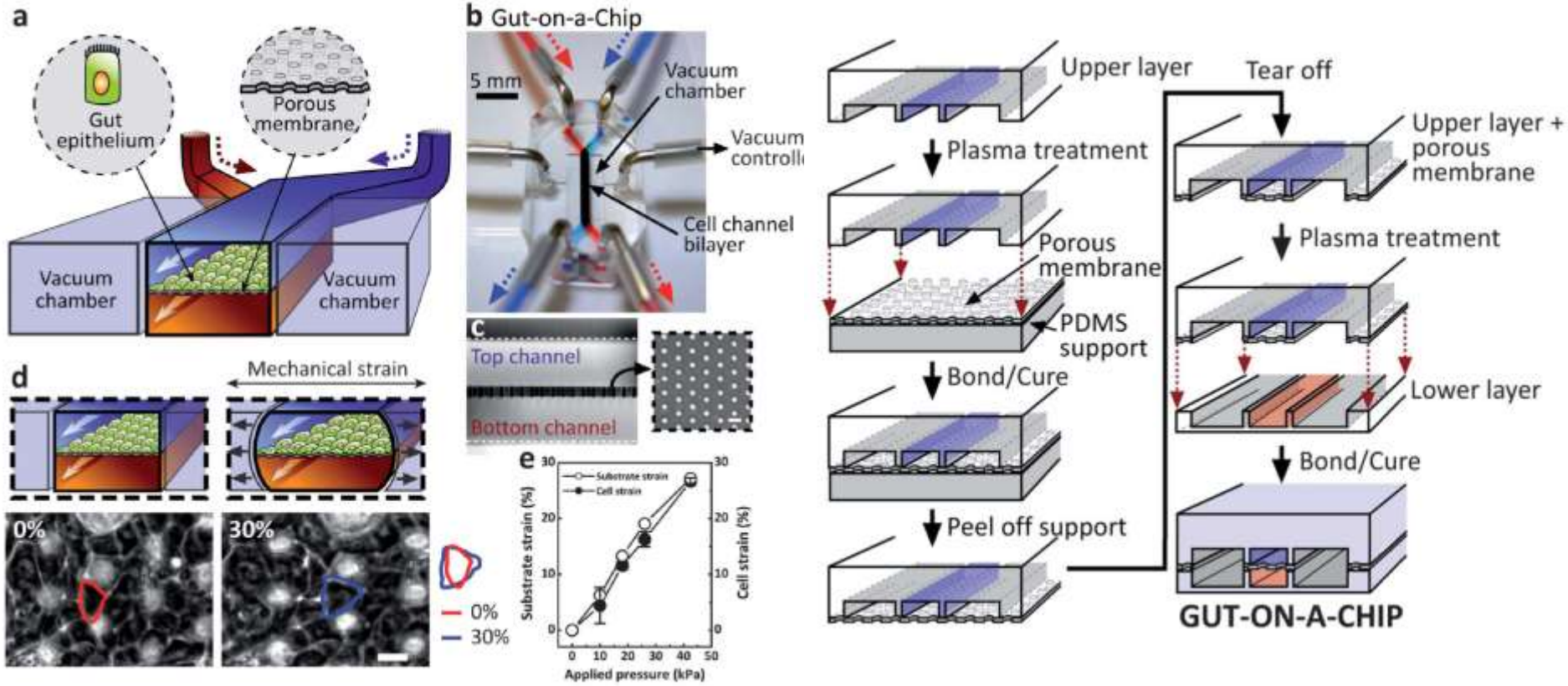
www.rsc.org/loc

PAPER

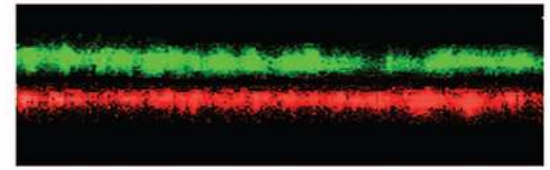
Human gut-on-a-chip inhabited by microbial flora that experiences intestinal peristalsis-like motions and flow†‡

Hyun Jung Kim,[a] Dongeun Huh,[a] Geraldine Hamilton[a] and Donald E. Ingber*[abc]

Received 18th January 2012, Accepted 5th March 2012
DOI: 10.1039/c2lc40074i

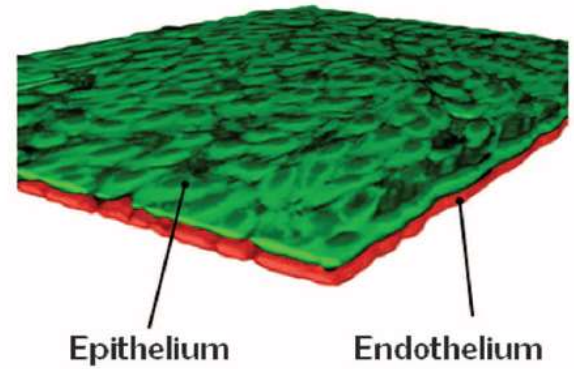


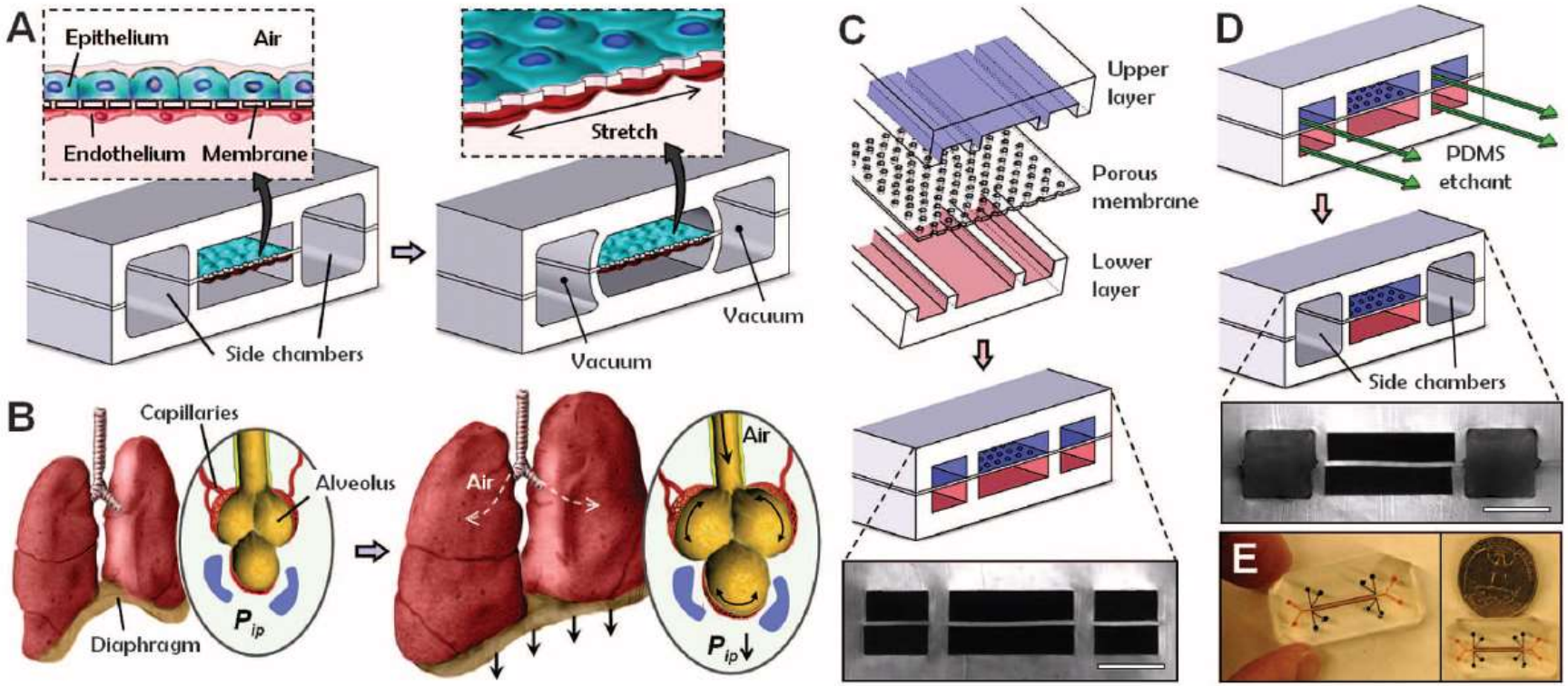
Reconstituting Organ-Level Lung Functions on a Chip



Dongeun Huh,[1,2] Benjamin D. Matthews,[2,3] Akiko Mammoto,[2] Martín Montoya-Zavala,[1,2] Hong Yuan Hsin,[2] Donald E. Ingber[1,2,4]*

Here, we describe a biomimetic microsystem that reconstitutes the critical functional alveolar-capillary interface of the human lung. This bioinspired microdevice reproduces complex integrated organ-level responses to bacteria and inflammatory cytokines introduced into the alveolar space. In nanotoxicology studies, this lung mimic revealed that cyclic mechanical strain accentuates toxic and inflammatory responses of the lung to silica nanoparticles. Mechanical strain also enhances epithelial and endothelial uptake of nanoparticulates and stimulates their transport into the underlying microvascular channel. Similar effects of physiological breathing on nanoparticle absorption are observed in whole mouse lung. Mechanically active "organ-on-a-chip" microdevices that reconstitute tissue-tissue interfaces critical to organ function may therefore expand the capabilities of cell culture models and provide low-cost alternatives to animal and clinical studies





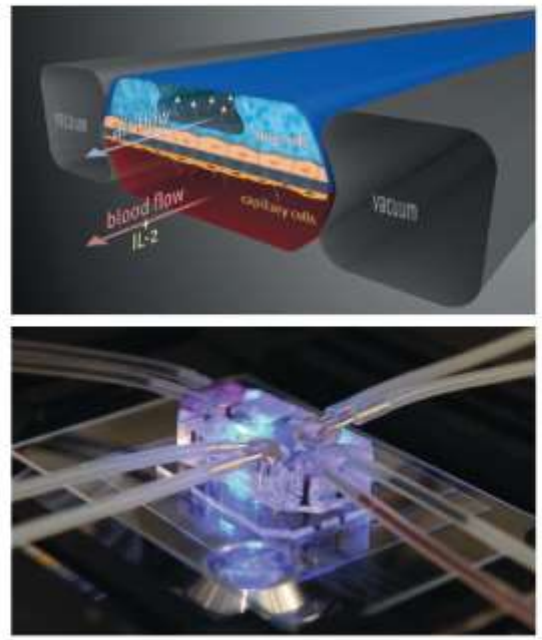
Lung-on-a-Chip Breathes New Life Into Drug Discovery

At first blush, the idea of growing facsimiles of lungs, kidneys, or other human organs in a bioreactor sounds vaguely diabolical. But researchers have been cultivating combinations of tissues for years in hopes that they would imitate working organs, and thereby serve as testing grounds for novel drugs to treat a wide variety of diseases. Now that promise has come a big step closer to reality. In this week's issue of *Science Translational Medicine* (*STM*), a team of academic and drug company researchers shows that an engineered "lung-on-a-chip" can not only faithfully model a serious respiratory ailment known as pulmonary edema, but can also accurately predict the toxicity of a compound that causes the disease and the ability of a new drug to prevent it.

"This really pushes the field to the next level," says Shuichi Takayama, a biomedical engineer at the University of Michigan, Ann Arbor, who has helped pioneer the field with his own lung-on-a-chip system. "People had been asking whether these systems could predict disease. Now it looks promising and we can ask 'How can we do this in the best way?'"

Efforts to incubate multiple cell types together to make organ mimics date back nearly 2 decades. In recent years, researchers have combined cell-culturing advances with microchip-patterning techniques to turn out artificial livers, kidneys, guts, and even brain tissue. Two years ago, a team led by Donald Ingber, a biomedical engineer at Harvard University, went so far as to make an artificial lung device complete with a layer of human capillary cells and lung cells on either side of a porous membrane, together with blood flow below the capillary layer and airflow above the lung cells. This entire assemblage was produced within a clear, flexible plastic material about the size of a computer thumb drive that could expand and contract, reproducing the mechanical motions involved in breathing (*Science*, 25 June 2010, p. 1662).

For their current study, Ingber and his colleagues used their lung-on-a-chip to model pulmonary edema. This life-threatening condition often follows heart failure, because fluid and blood-clotting proteins leak between endothelial cells in capillaries that pass through epithelial cells lining the lung and end up in alveolar pockets in the airways. It's also a common side effect among cancer patients given the chemotherapy drug interleukin-2 (IL-2). To see if their device would reproduce that effect, Ingber's team introduced IL-2 at a clinically relevant concentration into the blood flowing beneath capillary cells in their chip. Not only did the IL-2 cause the fluid leakage to occur, but this leakage increased fourfold when the chip repeatedly flexed to simulate the physical motions involved in breathing.



Disease mimic. In a lung-on-a-chip (*above*), IL-2 in the blood causes fluid to flow (*top*, white arrows) into the airway.

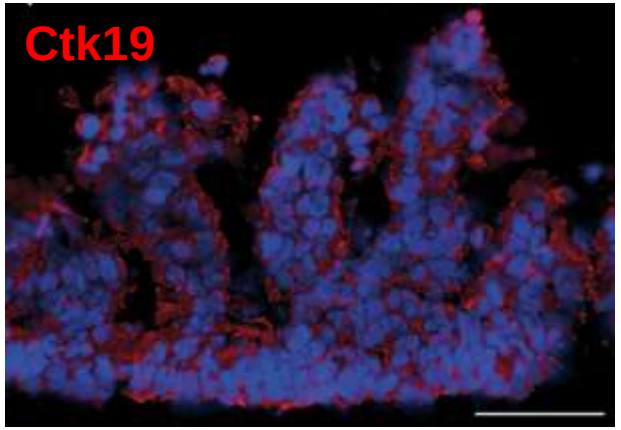
CREDITS: WYSS INSTITUTE (2)

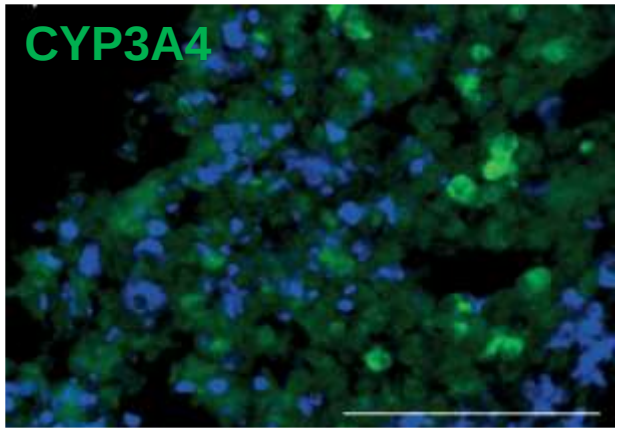
That success prompted Ingber's team to use this edema stand-in to screen drugs that might treat the disease. Previous work by other groups had shown that mechanical strain, such as that caused by breathing, can stimulate activity in TRPV4, a type of ion channel in capillary endothelial cells. This in turn can increase fluid leakage from capillaries into alveoli. Researchers at the pharmaceutical giant GlaxoSmithKline (GSK) had recently developed TRPV4-blocking drugs. Ingber's group partnered with Kevin Thorneloe and Allen McAlexander at GSK, and showed that the new TRPV4 blockers do in fact prevent IL-2's pulmonary edema side effects. In a separate study in the same issue of *STM*, the GSK team documented similar beneficial effects of TRPV4 inhibition in mice models of pulmonary edema caused by heart failure.

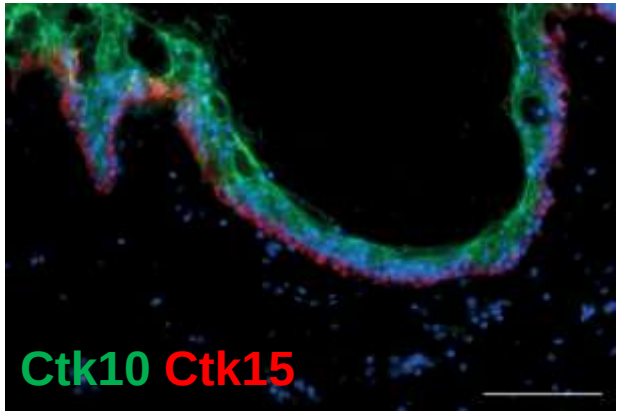
Ingber says the new results are a proof of principle that organs on chips can be a useful tool for researchers looking to screen new drugs and sort out mechanisms involved in disease. Down the road, that could limit the pharmaceutical industry's reliance on testing new drugs on animals. Of the candidate drugs that make it through animal testing, only a paltry 10% work in humans and make it to market. So any improvement could make a big impact.

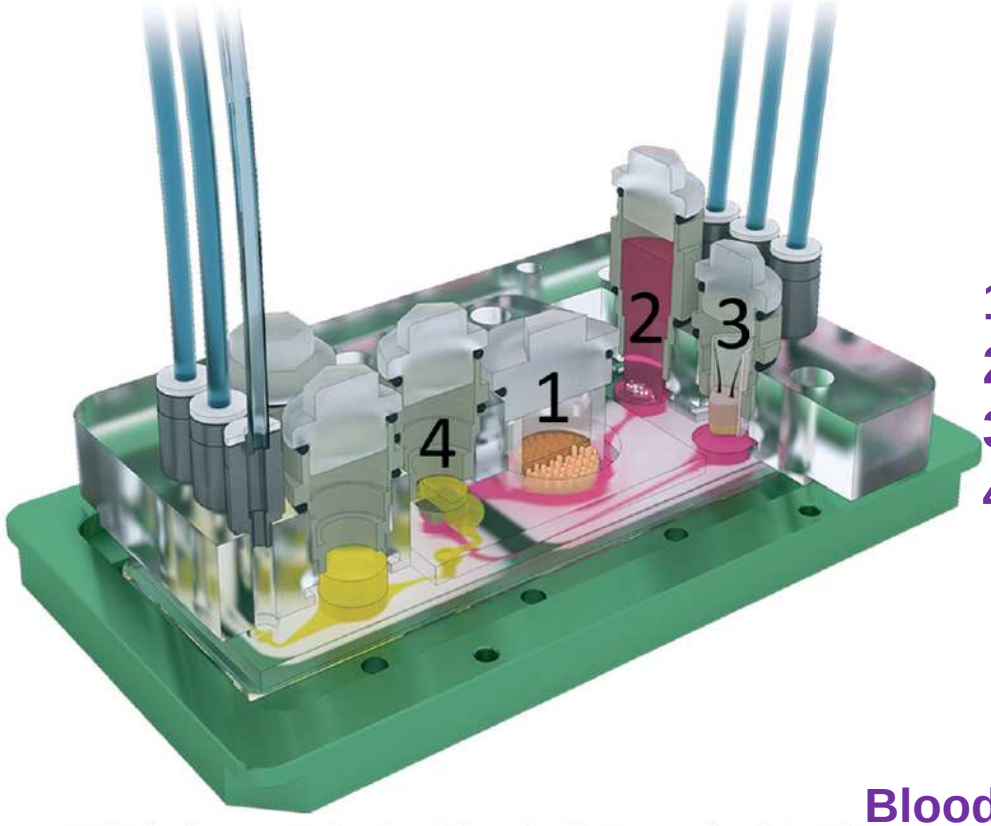
–ROBERT F. SERVICE

多器官晶片



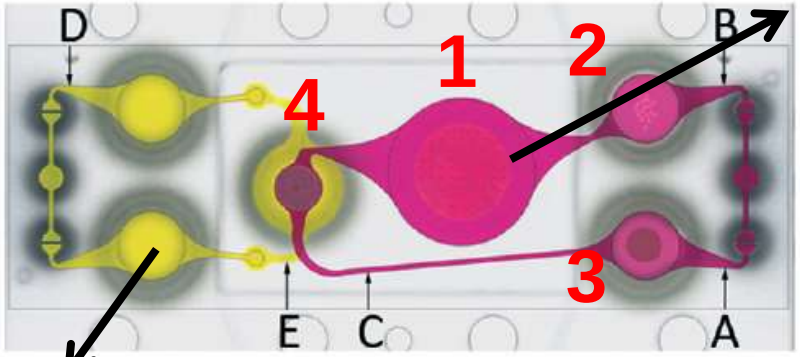






1. Intestine
2. Liver
3. Skin
4. Kidney

Blood flow circuit



Excretory flow circuit

Lab Chip, 2015, 15, 2688-2699

多色奈米晶片檢測感染源

Lab on a Chip

COMMUNICATION

View Article Online
View Journal | View Issue

Multicolored silver nanoparticles for multiplexed disease diagnostics: distinguishing dengue, yellow fever, and Ebola viruses†

Chun-Wan Yen,[ab] Helena de Puig,[c] Justina O. Tam,[ab] José Gómez-Márquez,[d] Irene Bosch,[ab] Kimberly Hamad-Schifferli*[ce] and Lee Gehrke*[af]

Cite this: *Lab Chip*, 2015, 15, 1638

Received 15th January 2015,
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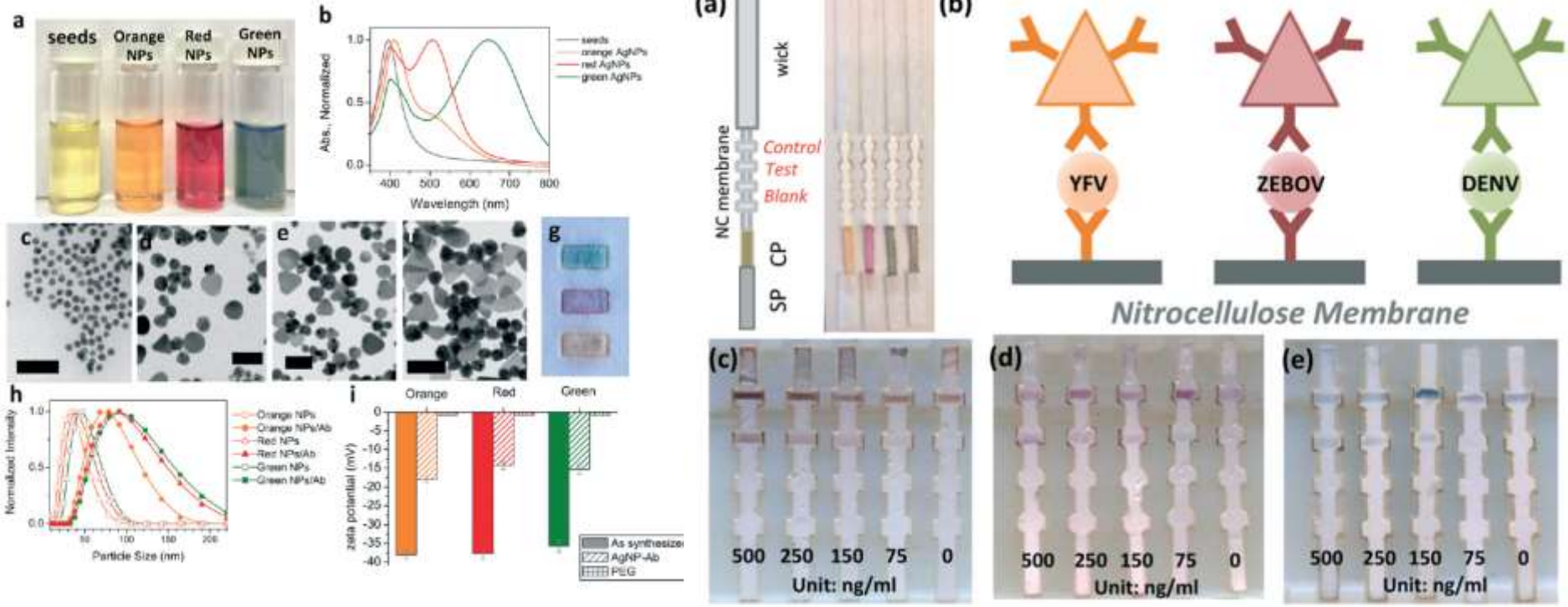
DOI: 10.1039/c5lc00055f



利用晶片測定細菌抗藥性

Lab on a Chip

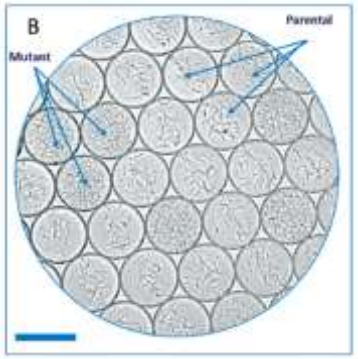
PAPER View Article Online View Journal

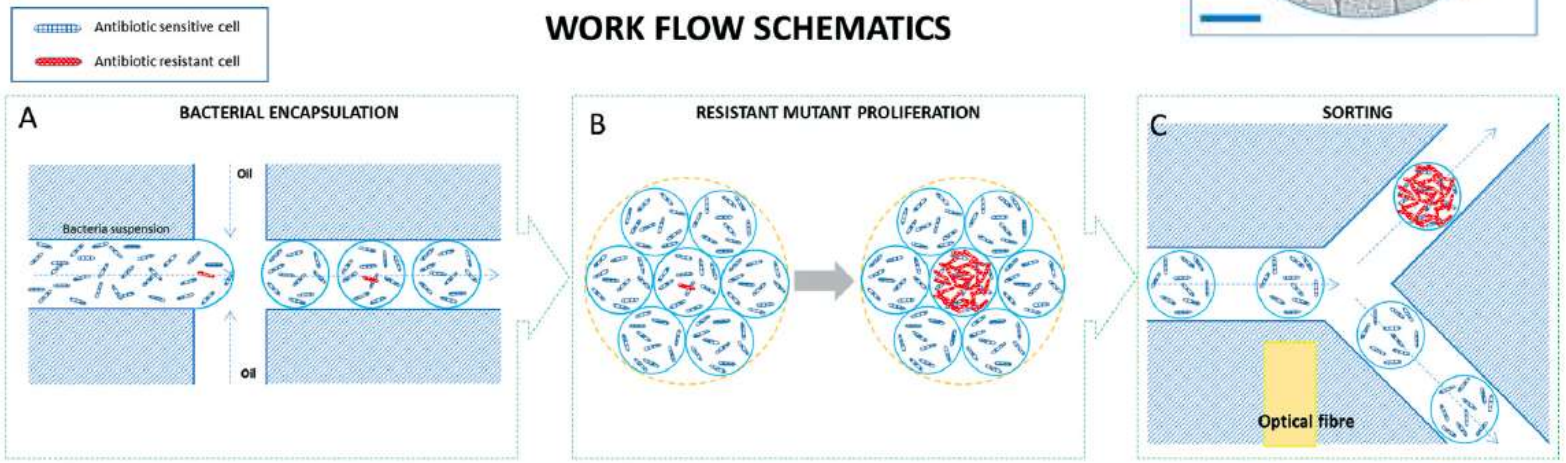
High-throughput screening of antibiotic-resistant bacteria in picodroplets†

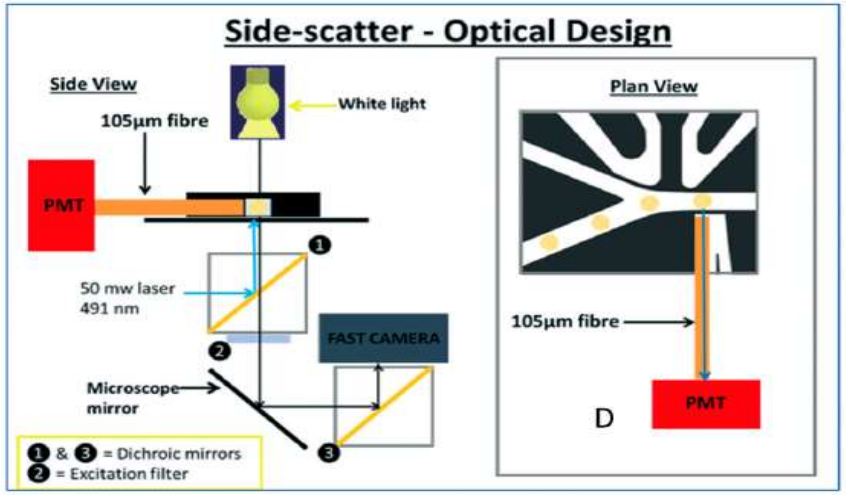
X. Liu,*[a] R. E. Painter,[b] K. Enesa,[a] D. Holmes,[a] G. Whyte,[c] C. G. Garlisi,[b] F. J. Monsma Jr.,[b] M. Rehak,[a] F. F. Craig[a] and C. A. Smith*[a]

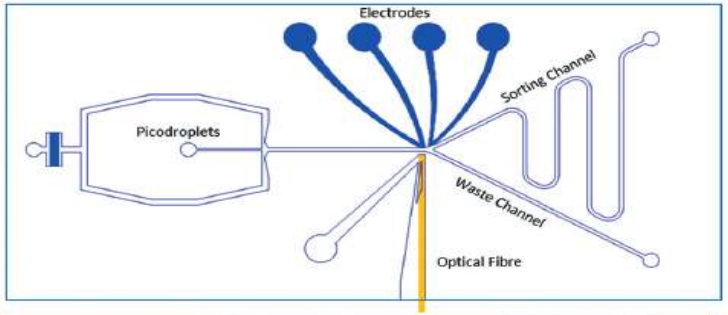
CrossMark

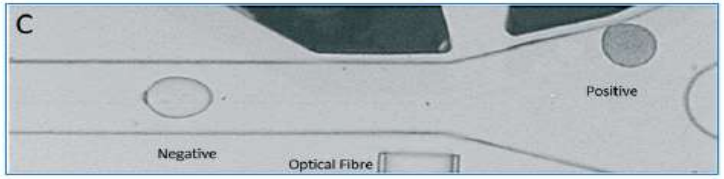
Cite this: DOI: 10.1039/c6lc00180g











利用晶片篩選高品質的精子

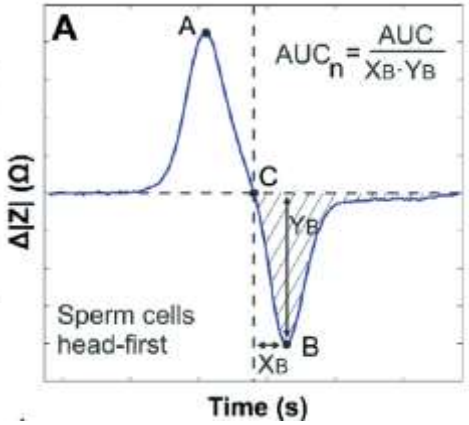
Lab on a Chip

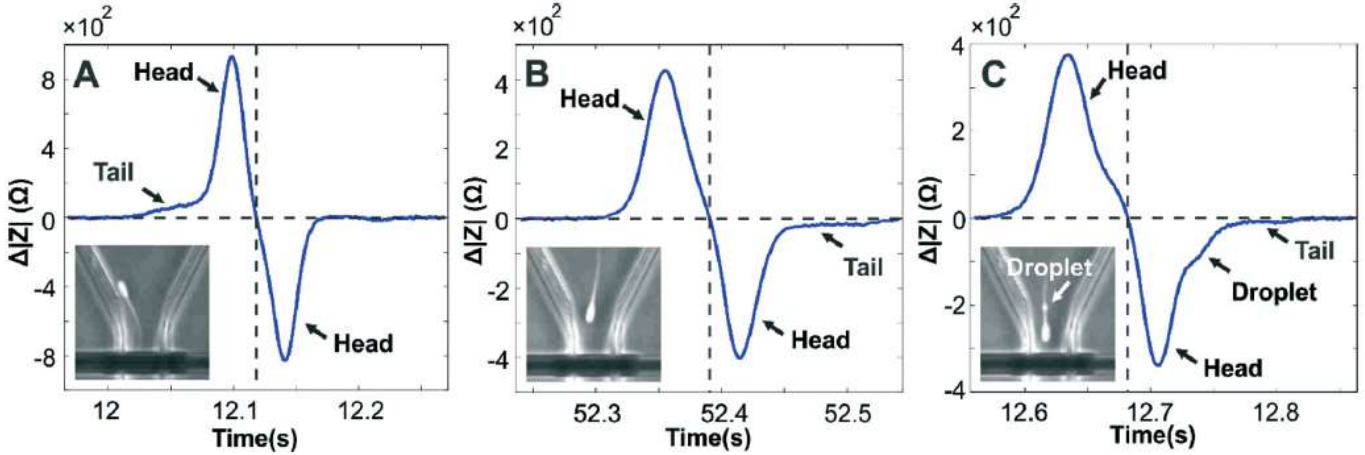
PAPER

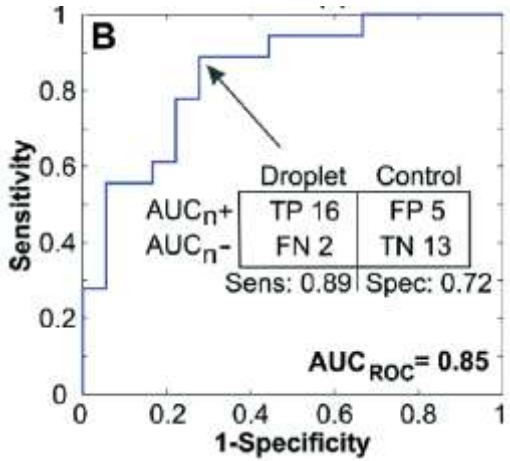
View Article Online
View Journal

Towards microfluidic sperm refinement: impedance-based analysis and sorting of sperm cells†

Cite this: DOI: 10.1039/c6lc00256k

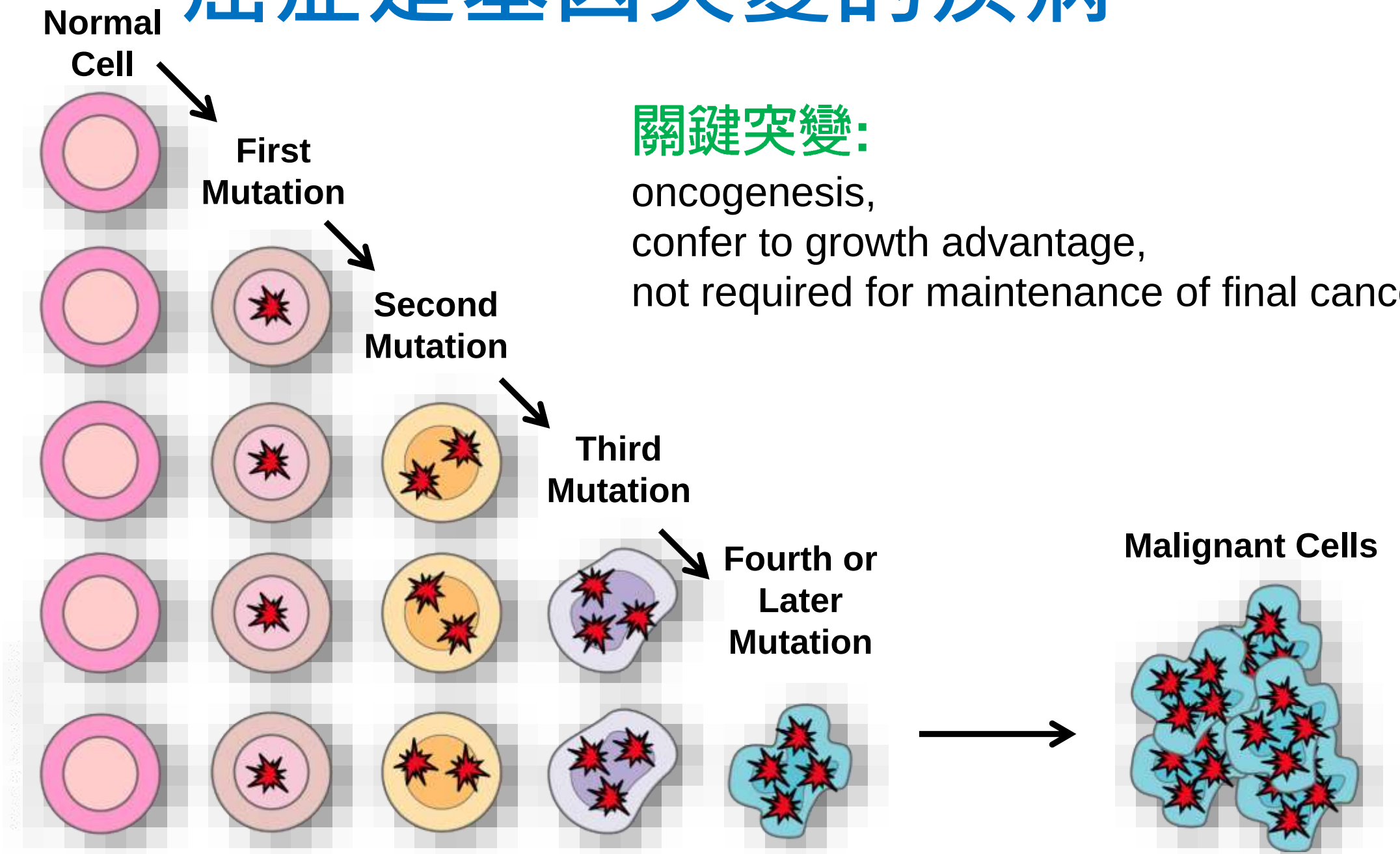






癌症需要什麼樣的生物晶片？

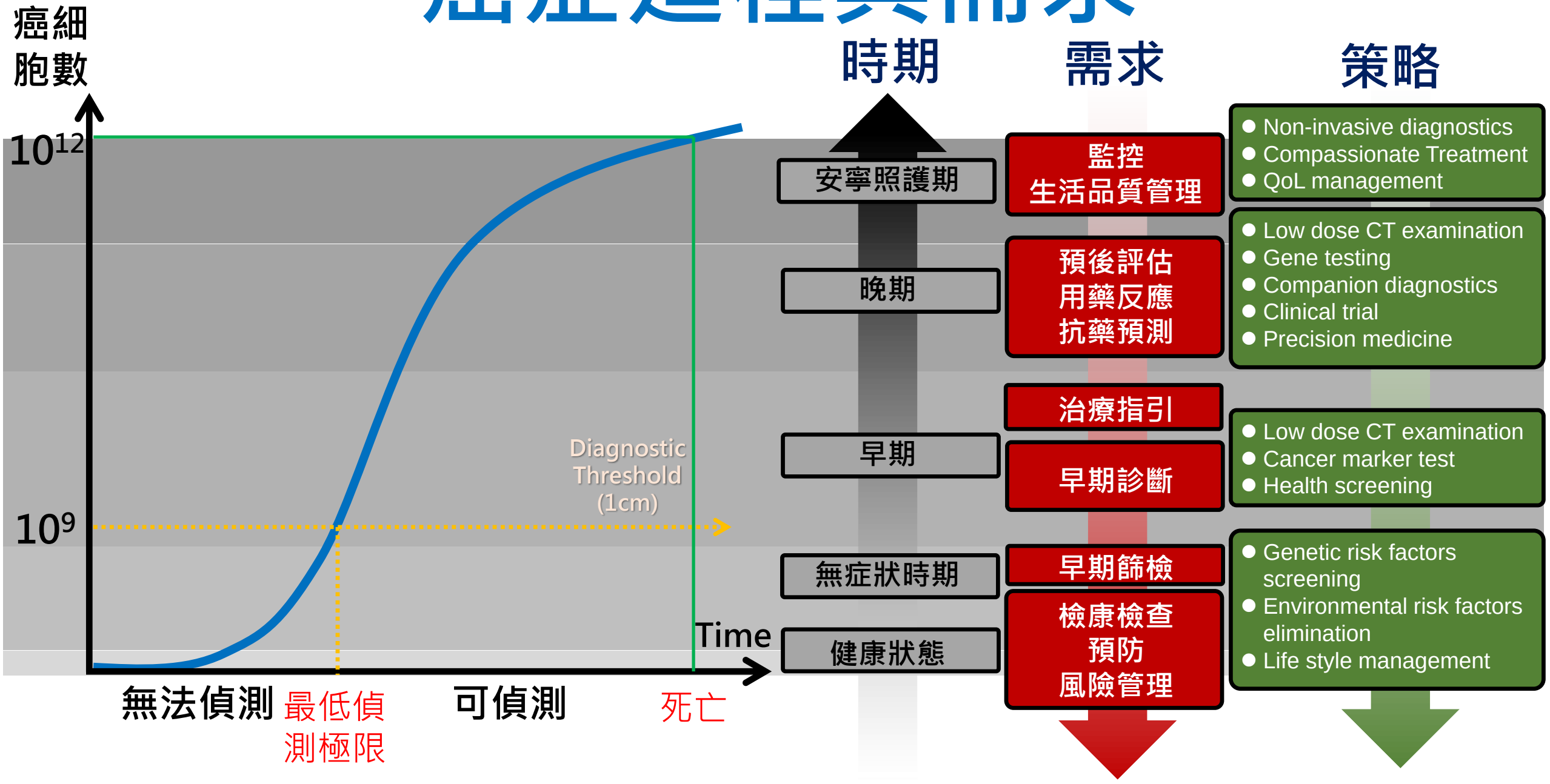
癌症是基因突變的疾病



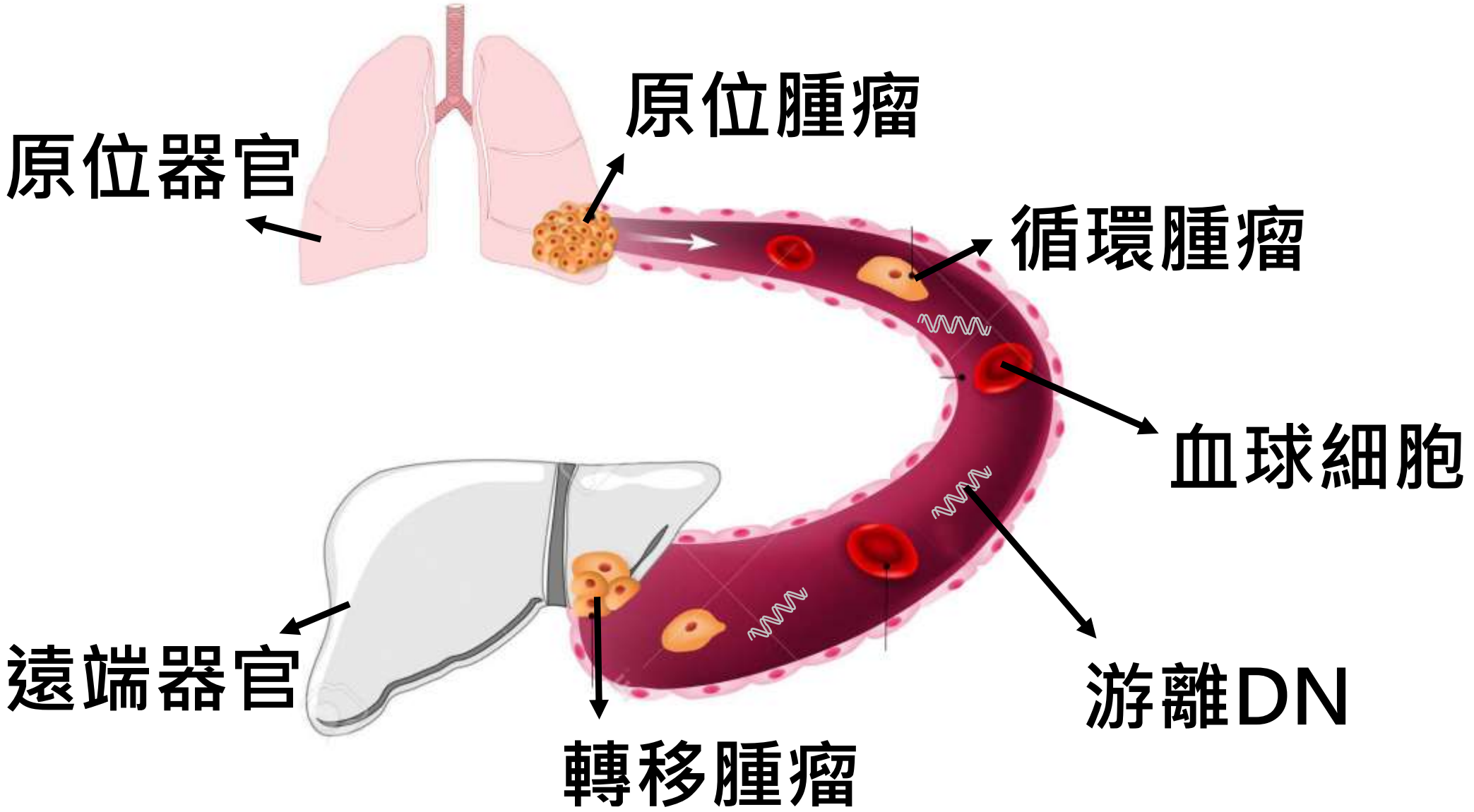
關鍵突變:

oncogenesis,
confer to growth advantage,
not required for maintenance of final cancer

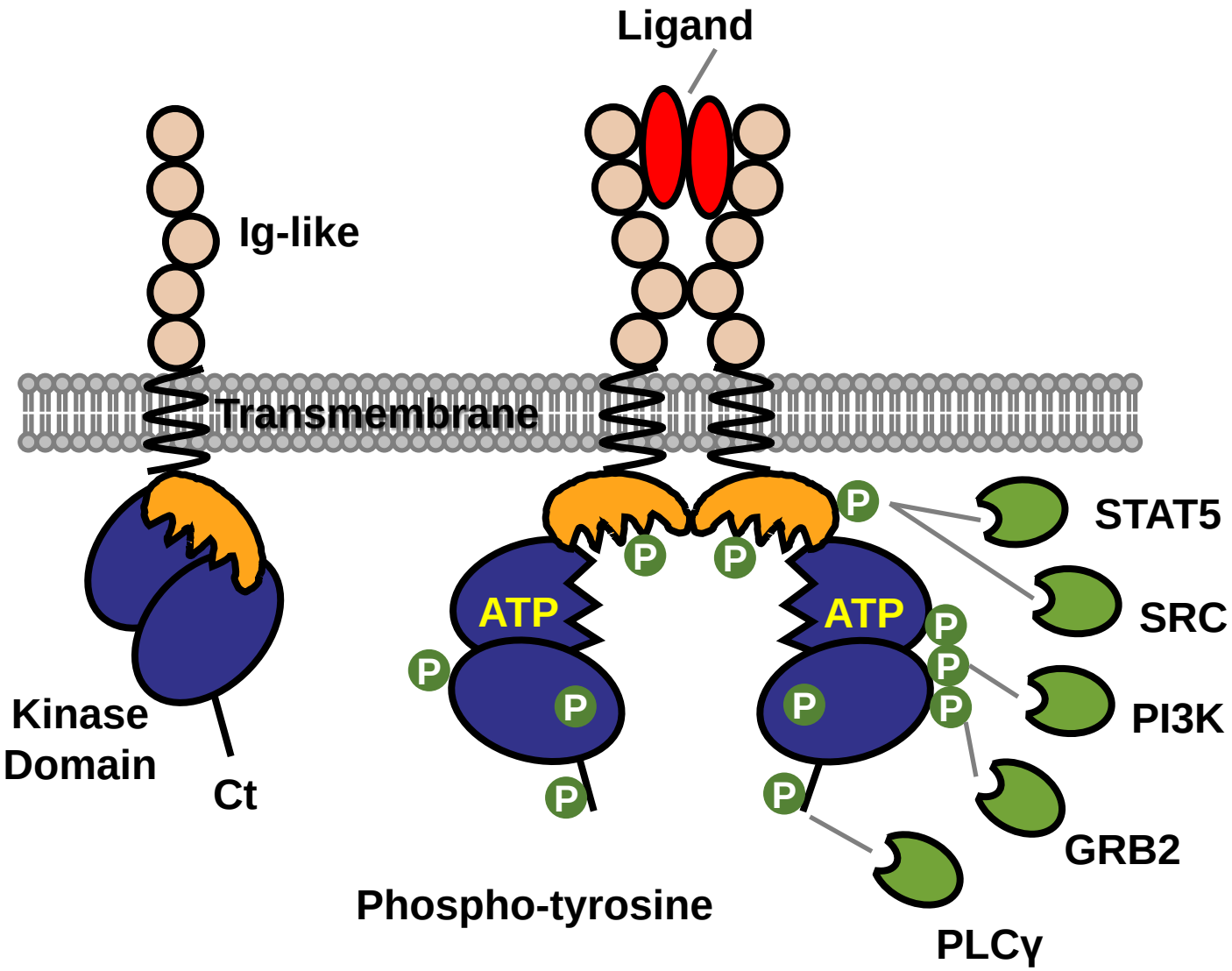
癌症進程與需求


癌細胞數
10^{12}
10^{9}
Diagnostic Threshold (1cm)
Time
無法偵測
最低偵測極限
可偵測
死亡
時期
安寧照護期
晚期
早期
無症狀時期
健康狀態
需求
監控 生活品質管理
預後評估 用藥反應 抗藥預測
治療指引
早期診斷
早期篩檢
檢康檢查 預防 風險管理
策略
Non-invasive diagnostics
Compassionate Treatment
QoL management
Low dose CT examination
Gene testing
Companion diagnostics
Clinical trial
Precision medicine
Low dose CT examination
Cancer marker test
Health screening
Genetic risk factors screening
Environmental risk factors elimination
Life style management

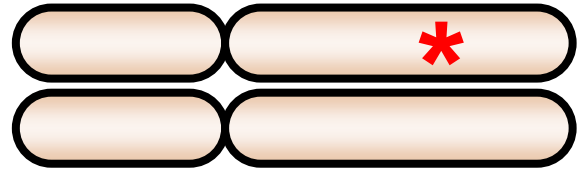
腫瘤細胞再活體內的分佈



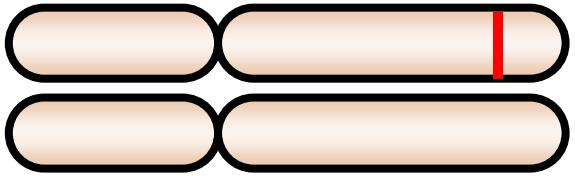
Driver Mutation in Cancer



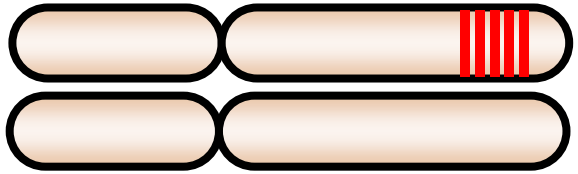
Mutation



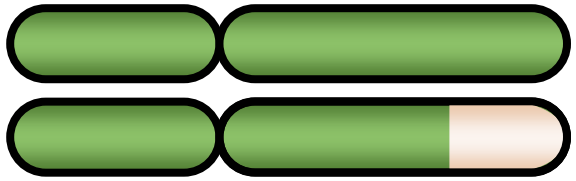
InDel



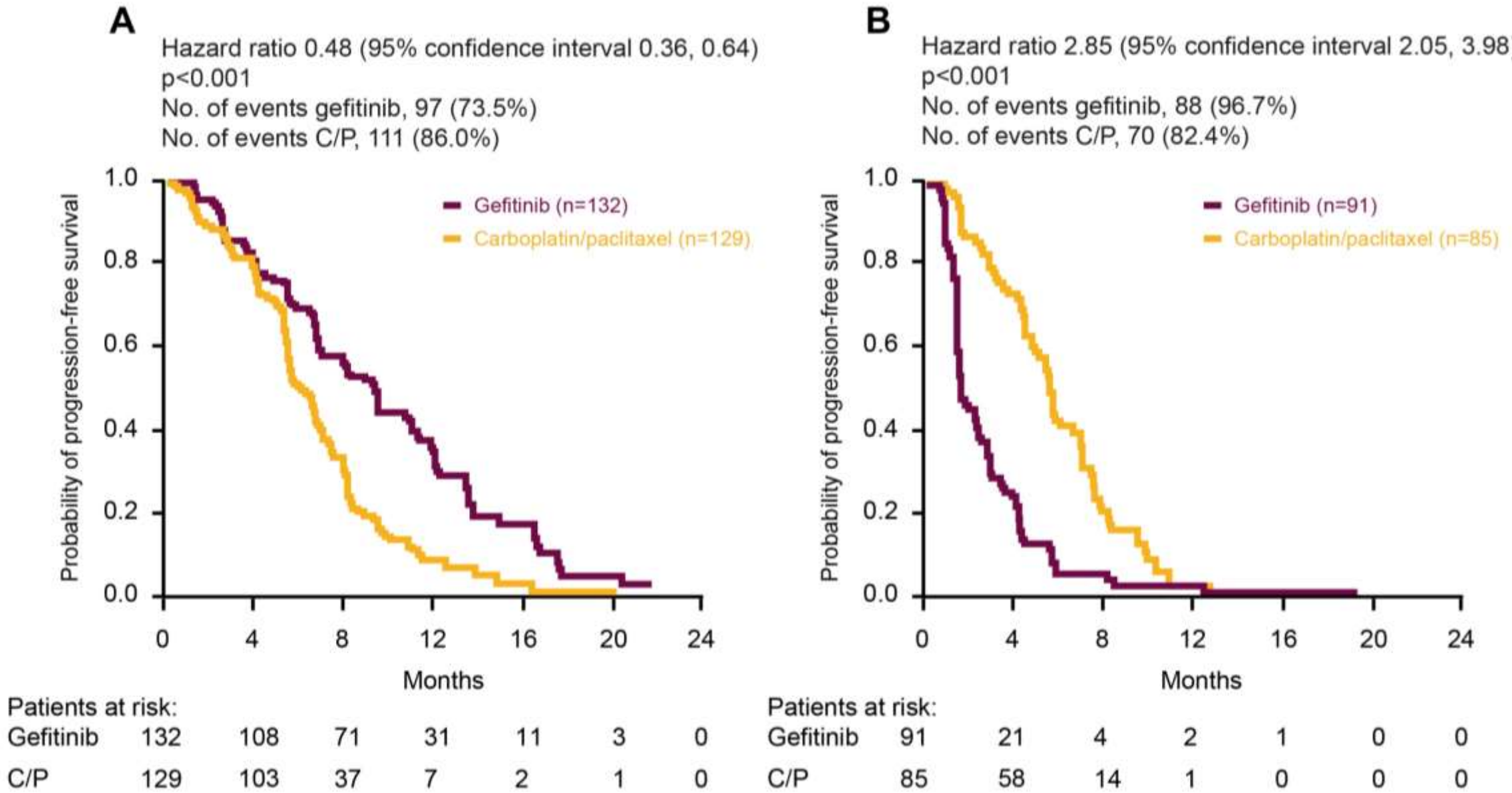
Amplification



Translocation



標靶藥物臨床試驗



N Engl J Med. 2009, Vol.361, 947-957

DNA Mutation Detection Process

DNA extraction

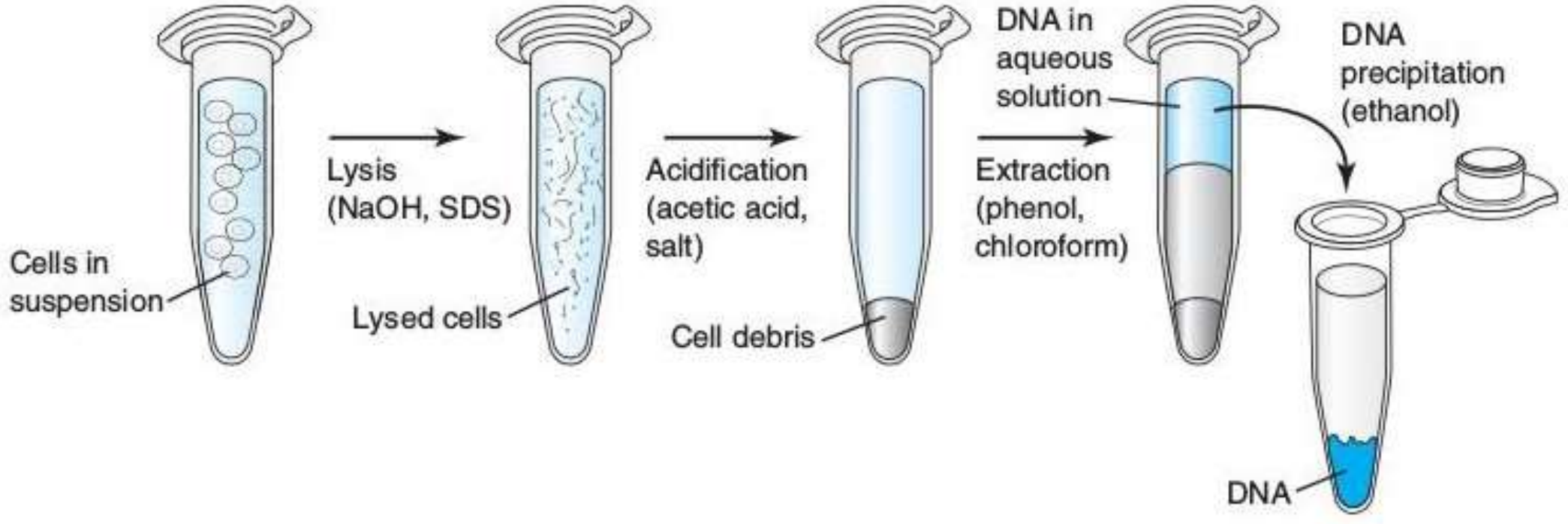
⬇

Biochemical reaction

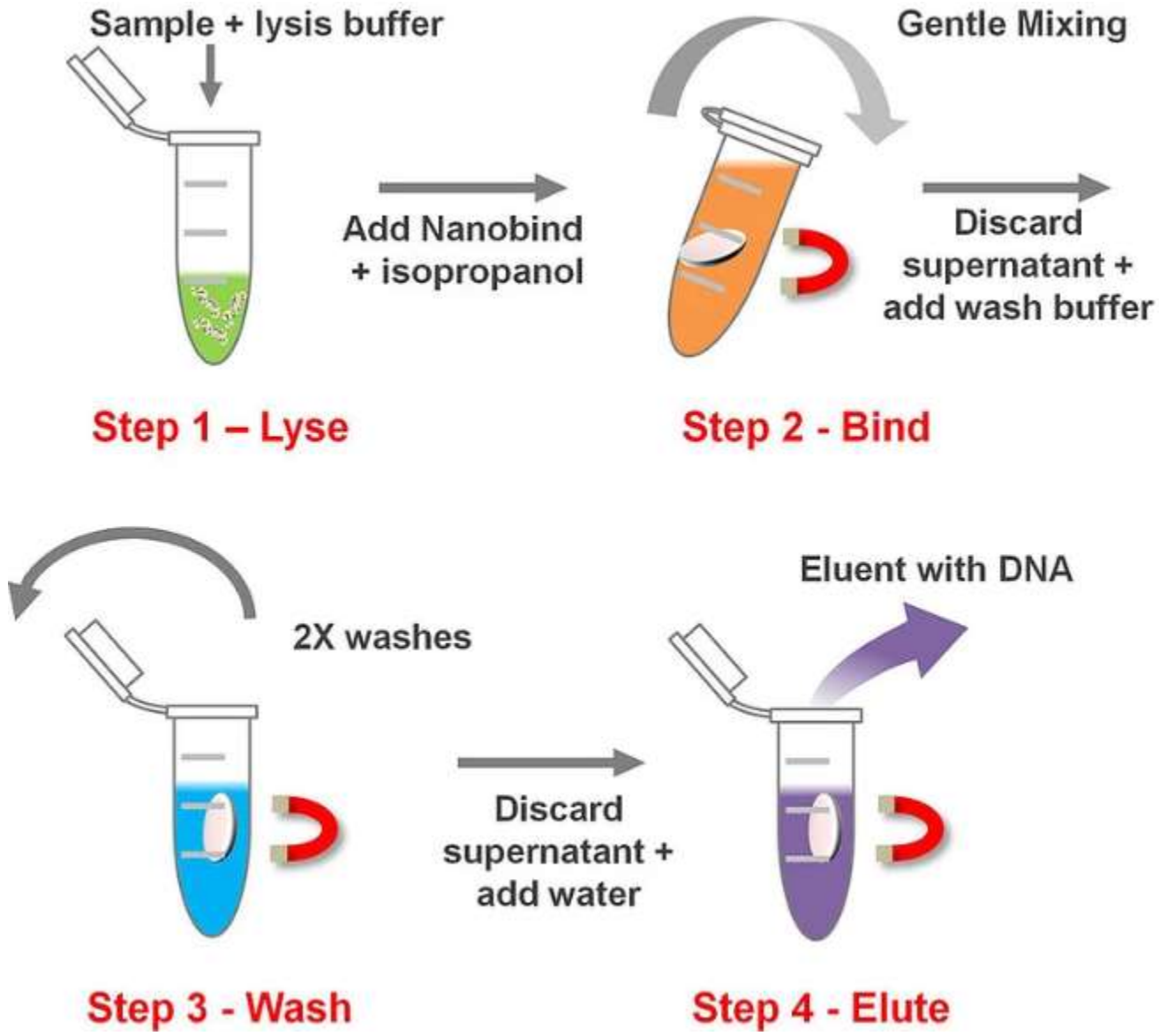
⬇

Products analysis

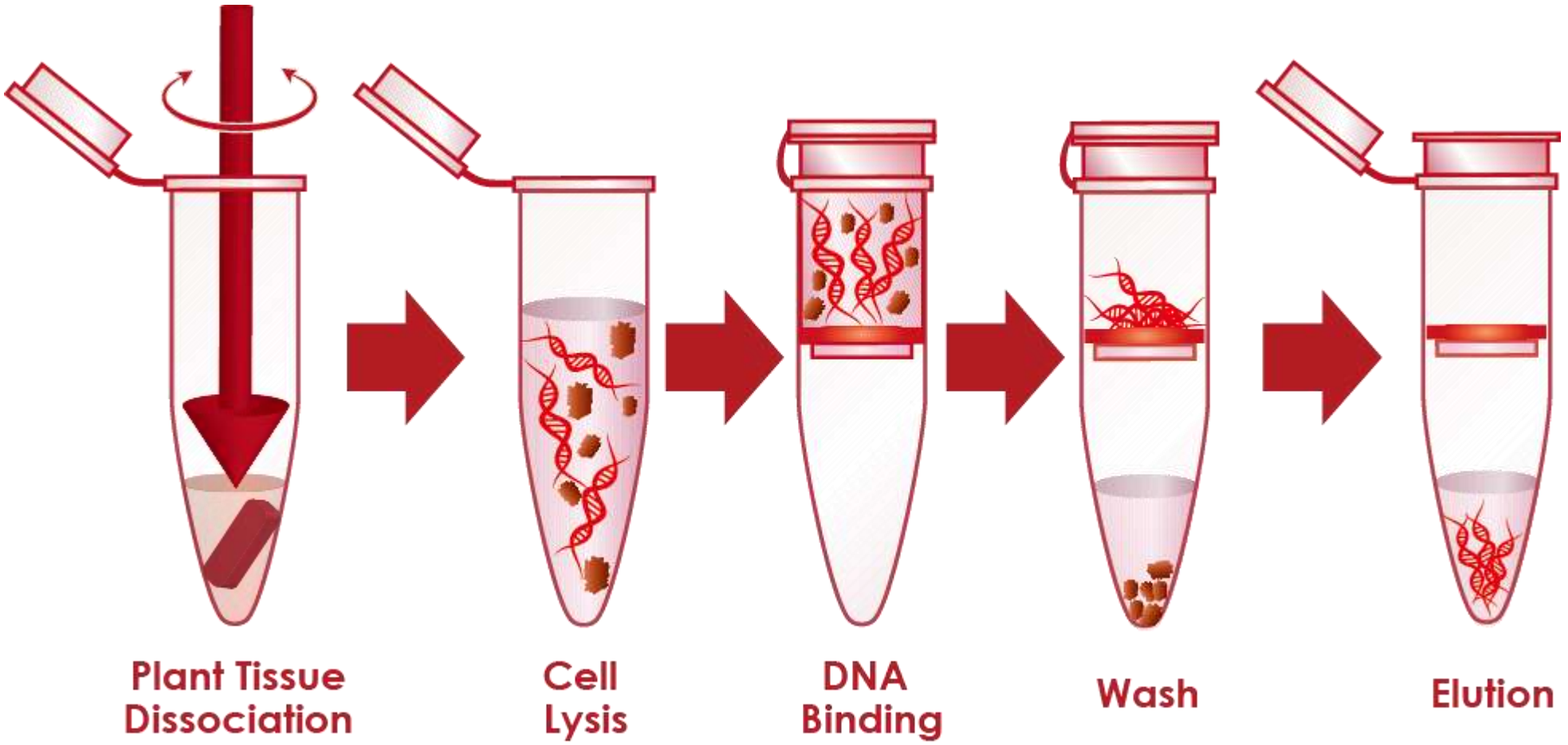
DNA Extraction – salt out method



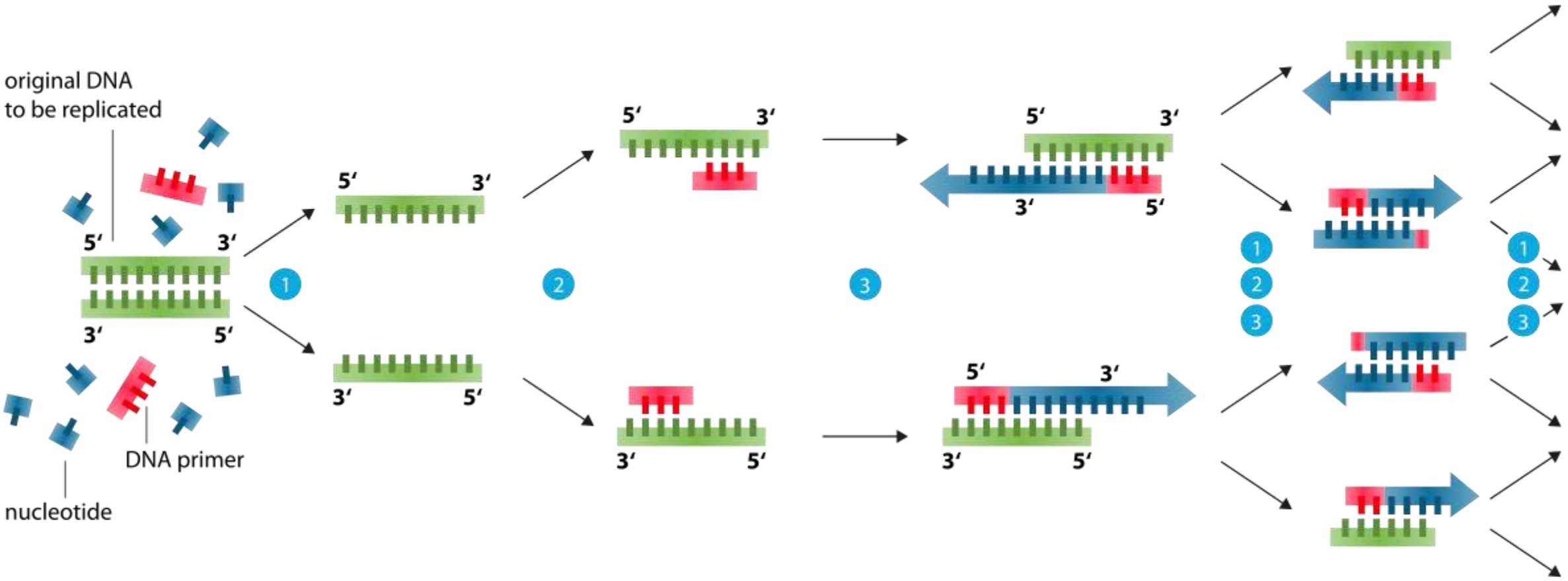
DNA Extraction – binding method



DNA Extraction – column method

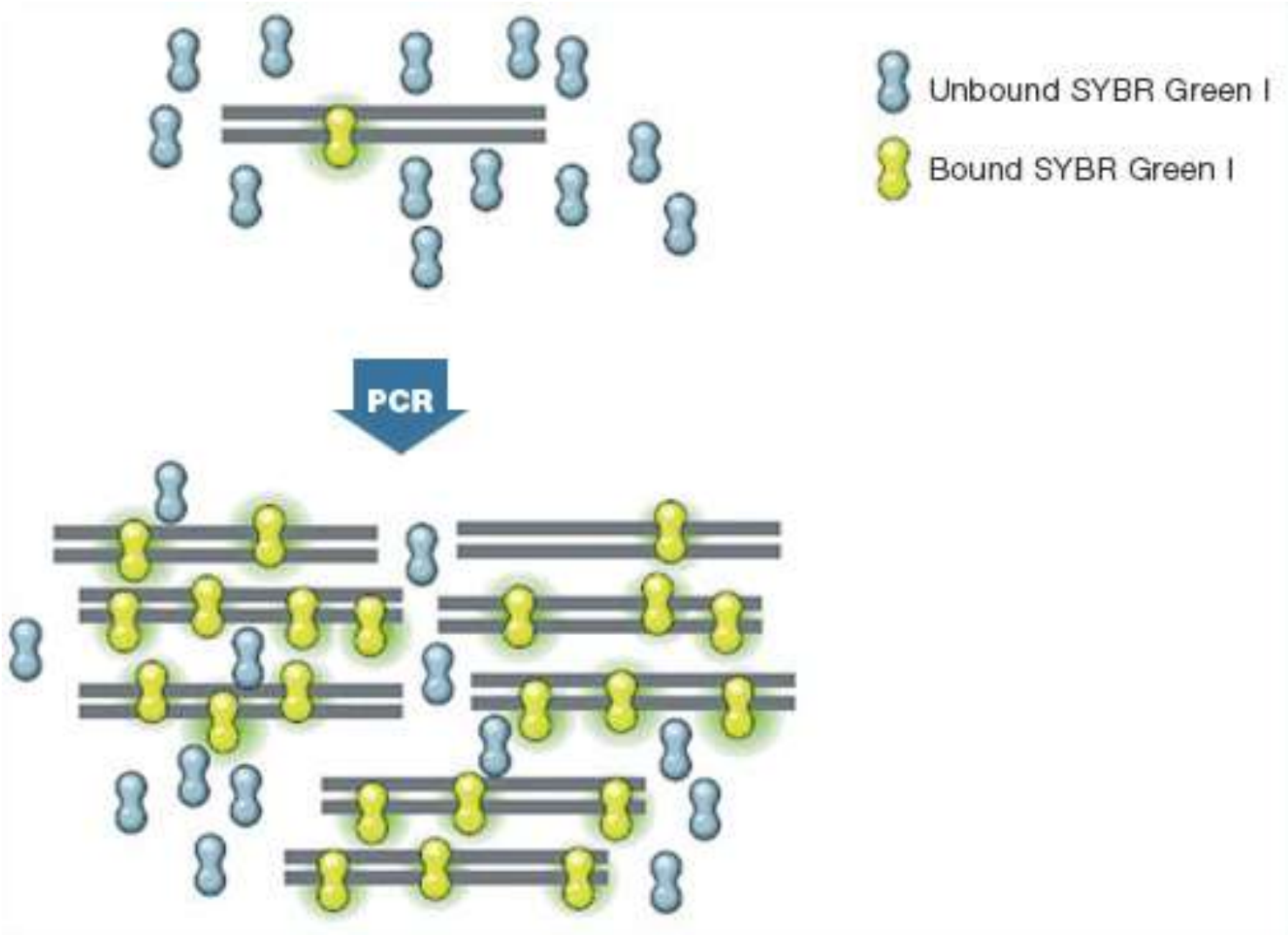


Biochemical Reaction - PCR

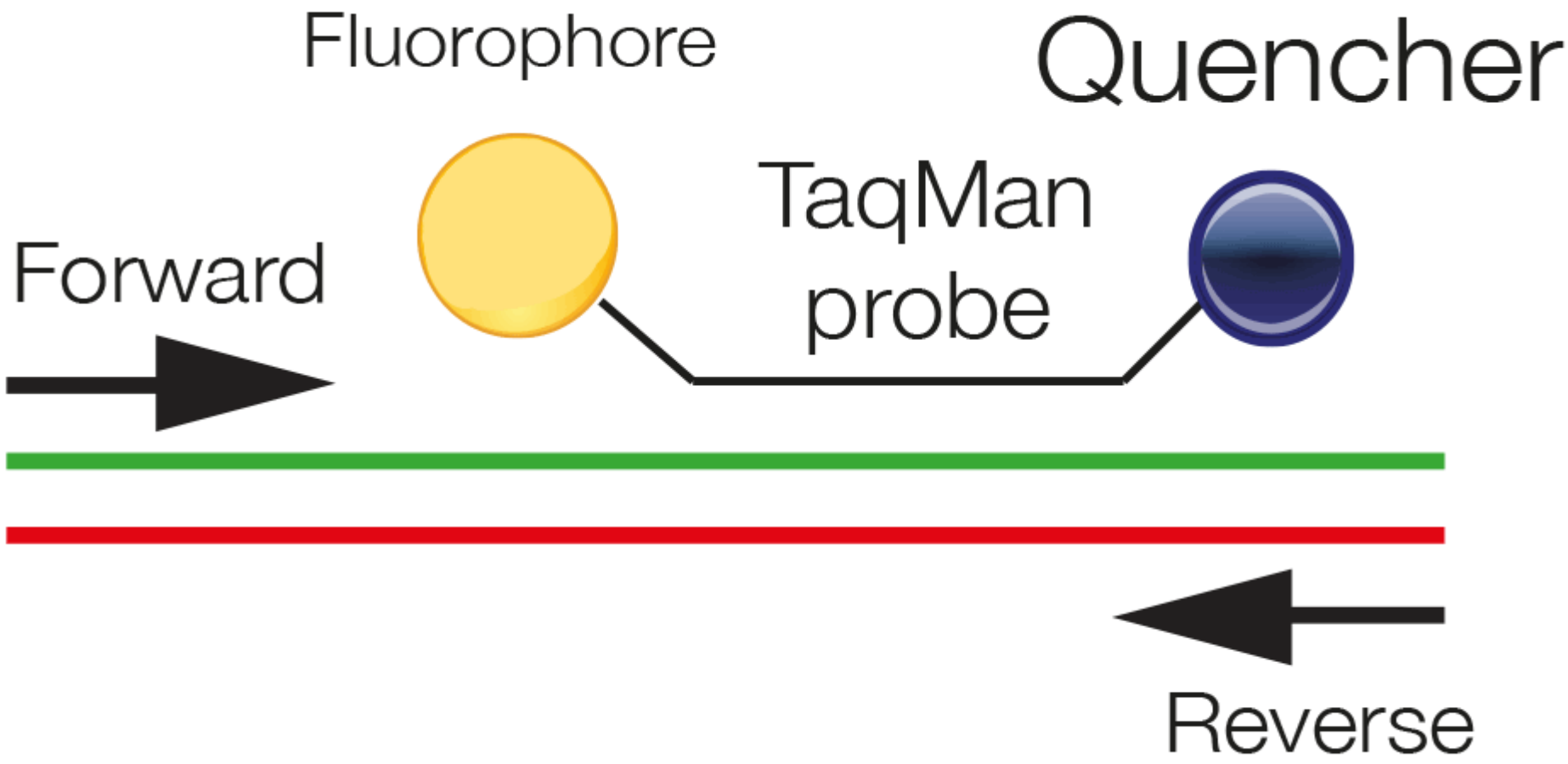


1. **Denaturation** at 94-96°C
2. **Annealing** at ~68°C
3. **Elongation** at ca. 72 °C

Products analysis – SYBR green

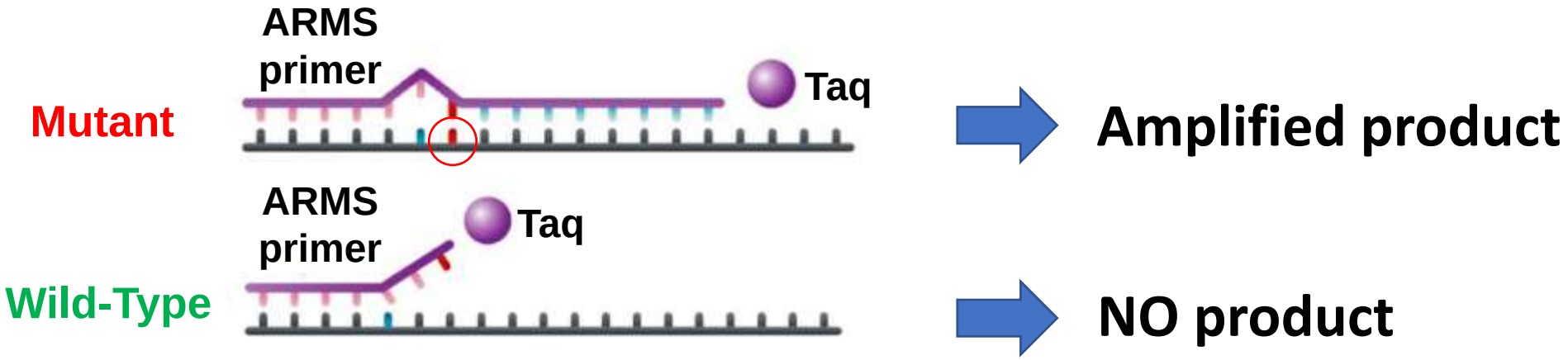


Products analysis – TaqMan

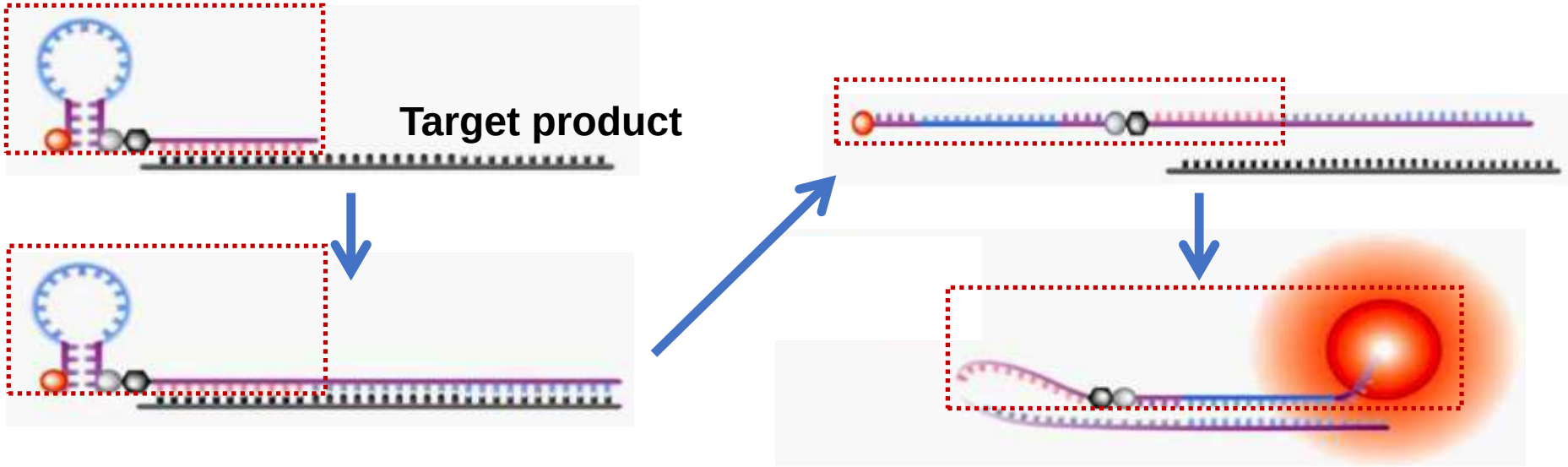


Products analysis – Scorpions ARMS

ARMS, Amplified Refractory Mutation System

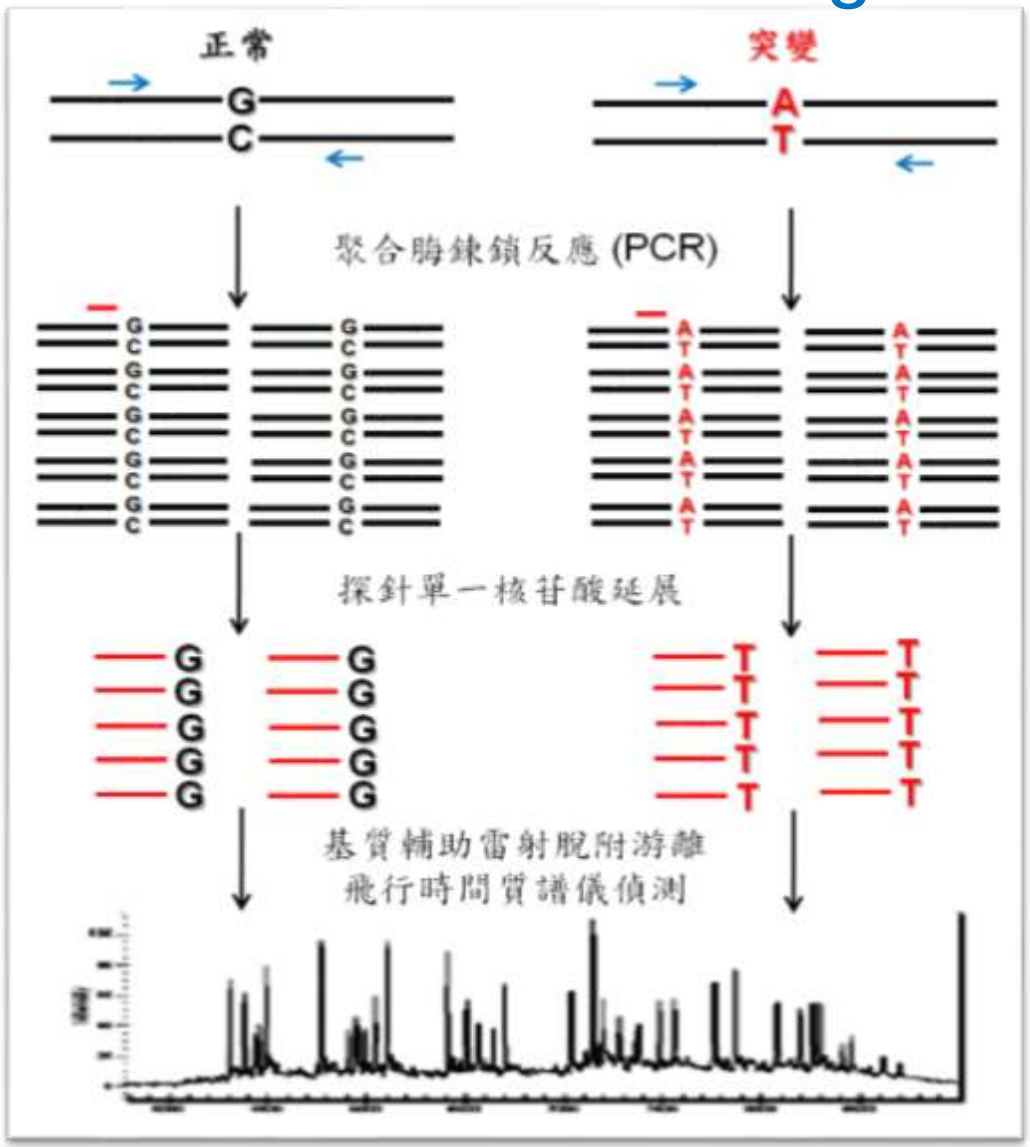


Scorpion primer



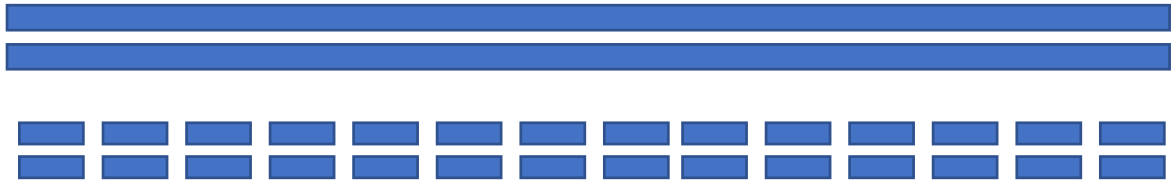
Products analysis – SNE

Single nucleotide extension



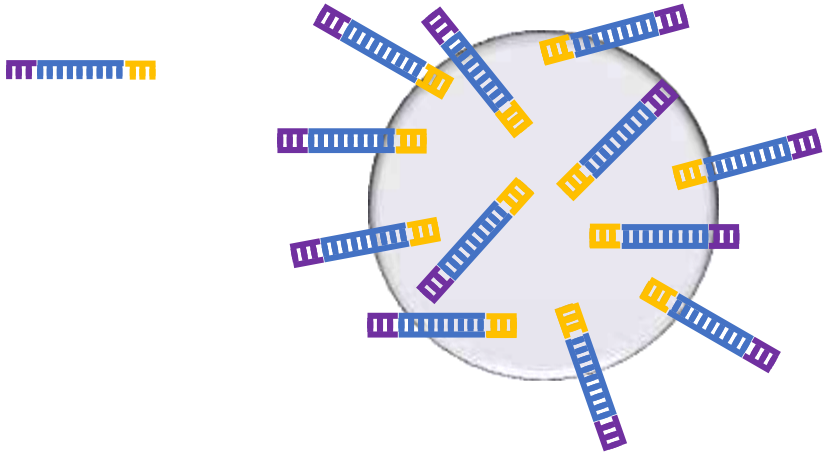
新一代定序儀

Next-generation Sequencer

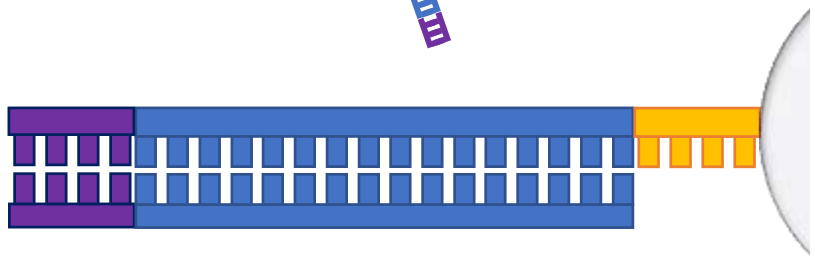


Fragmentation

Adapter Ligation

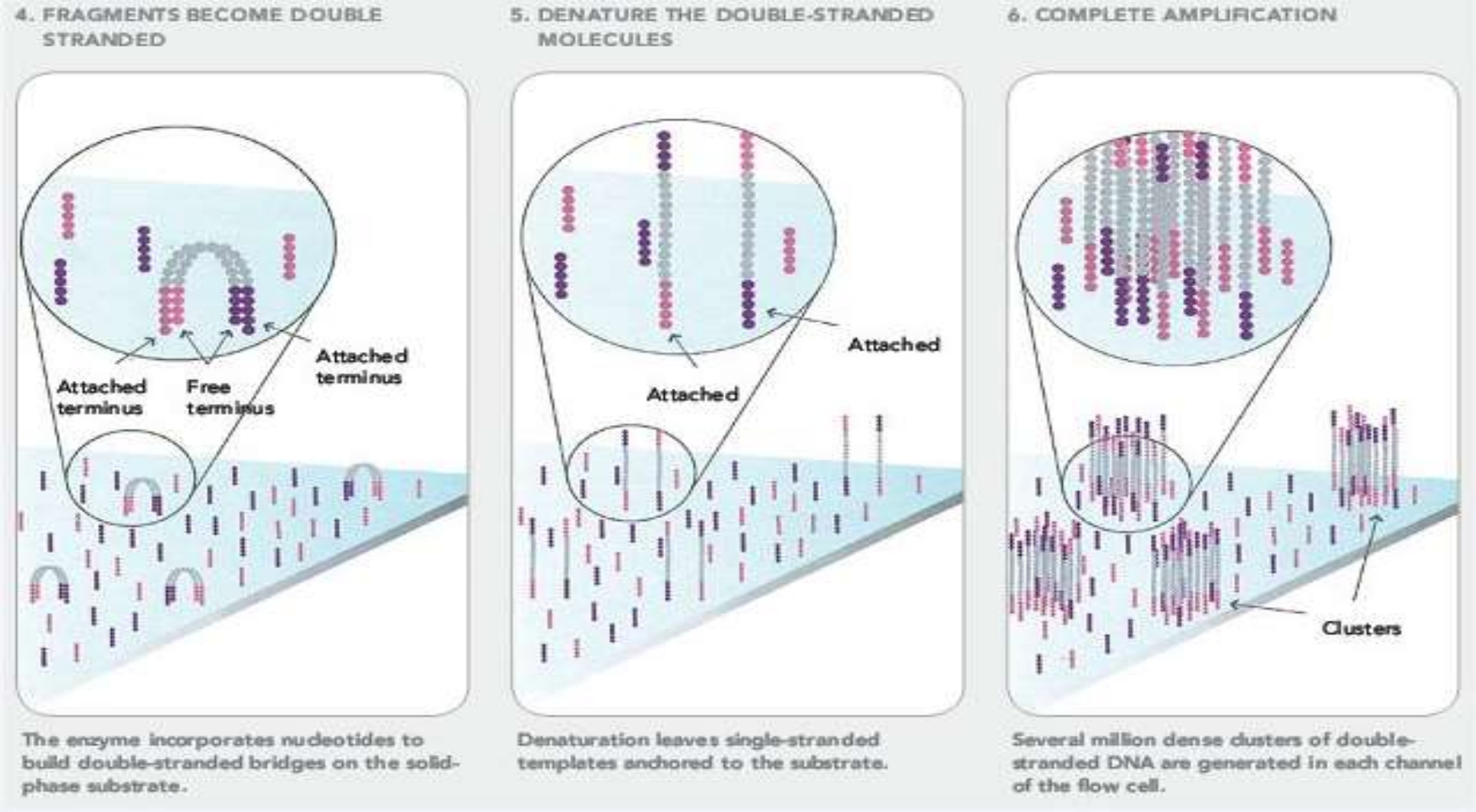


Library Preparation



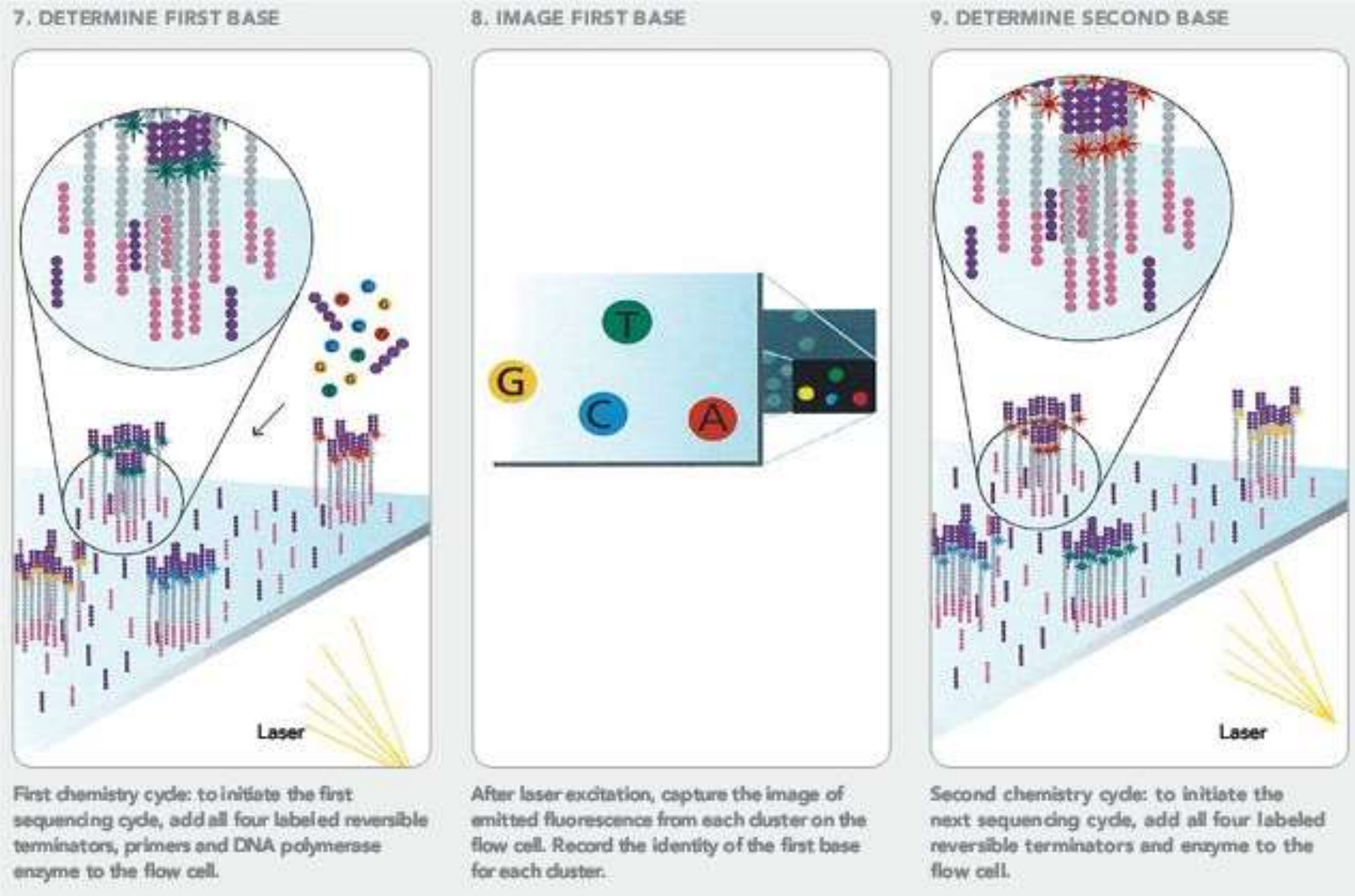
Sequencing

Illumina (Fluorescent nucleotide)



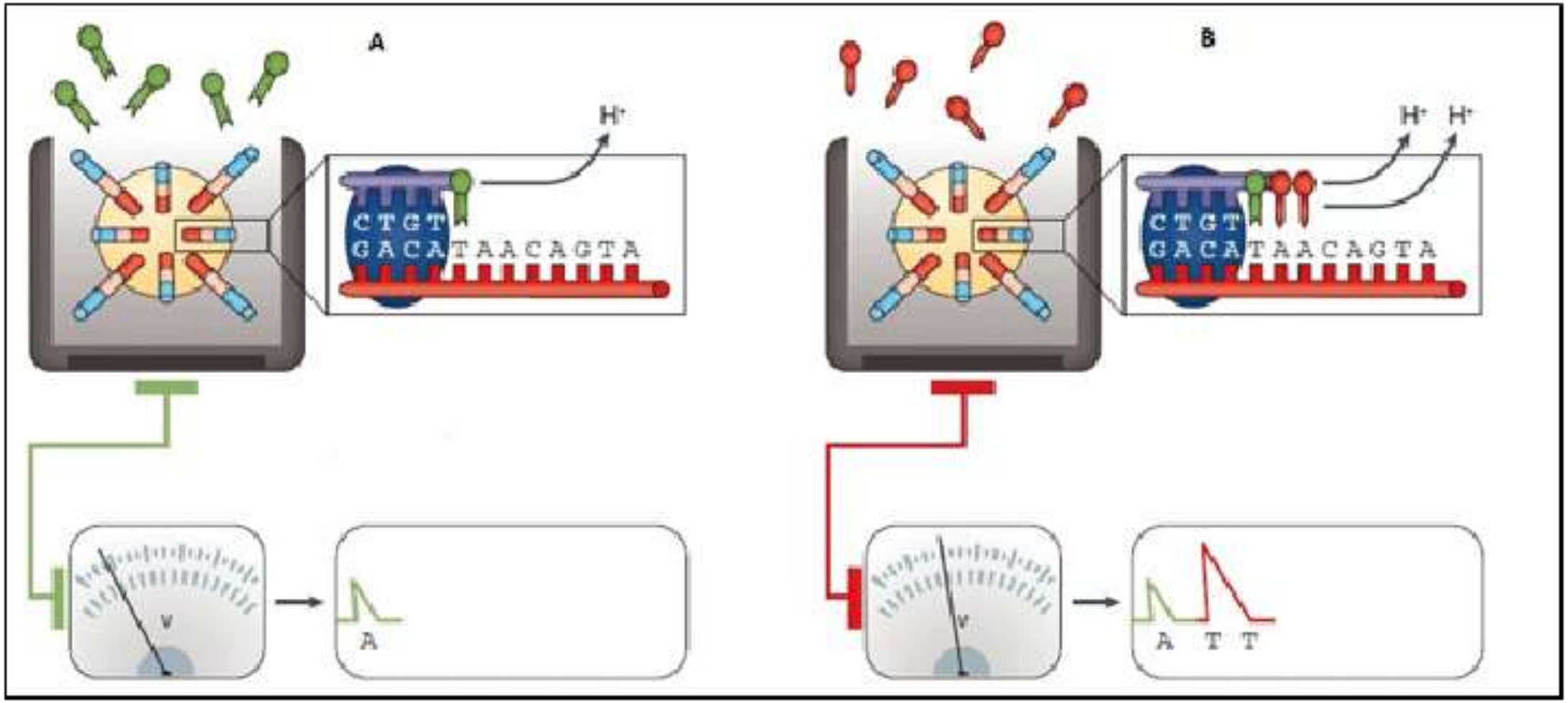
Repeated denaturation and extension results in localized amplification of single molecules in millions of unique locations across the flow cell surface. This process occurs in what is referred to as Illumina's "**cluster station**", an automated flow cell processor.

Illumina (Fluorescent nucleotide)



Products analysis – sequencing

Ion detection



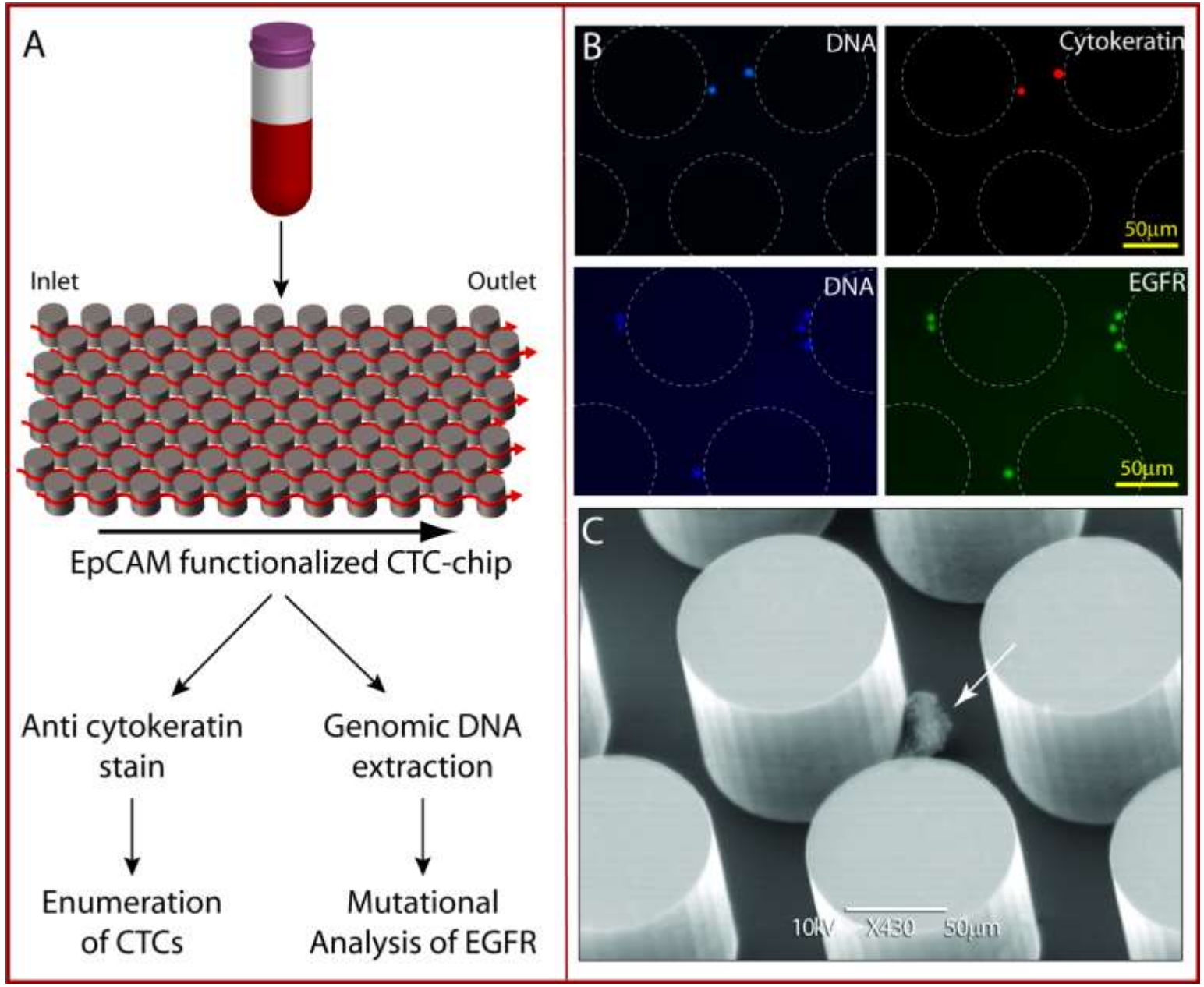
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

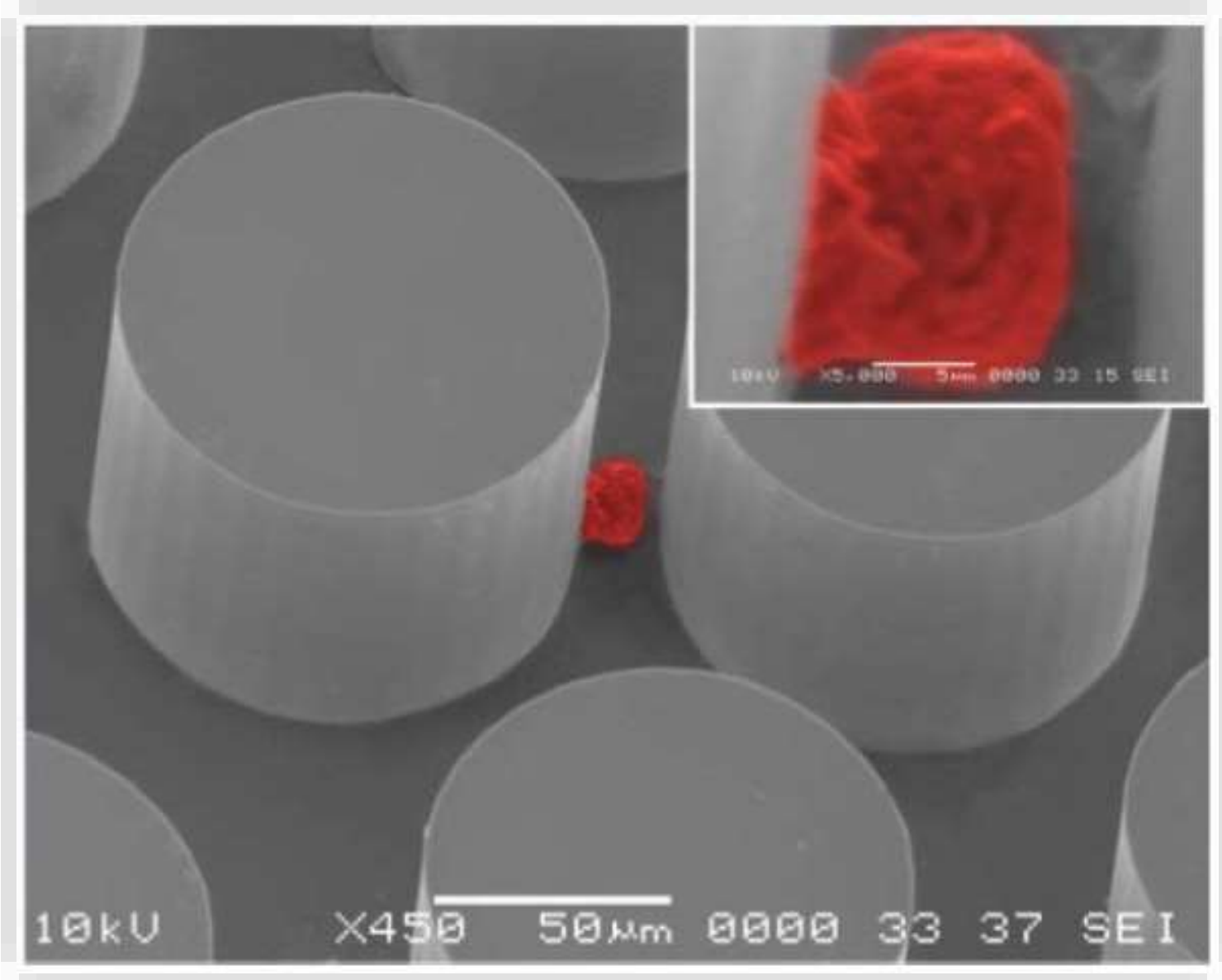
Detection of Mutations in *EGFR* in Circulating Lung-Cancer Cells

Shyamala Maheswaran, Ph.D., Lecia V. Sequist, M.D., M.P.H., Sunitha Nagrath, Ph.D., Lindsey Ulkus, B.S., Brian Brannigan, B.A., Chey V. Collura, M.S., Elizabeth Inserra, B.S., Sven Diederichs, Ph.D., A. John Iafrate, M.D., Ph.D., Daphne W. Bell, Ph.D., Subba Digumarthy, M.D., Alona Muzikansky, M.S., Daniel Irimia, Ph.D., Jeffrey Settleman, Ph.D., Ronald G. Tompkins, M.D., Thomas J. Lynch, M.D., Mehmet Toner, Ph.D., and Daniel A. Haber, M.D., Ph.D.

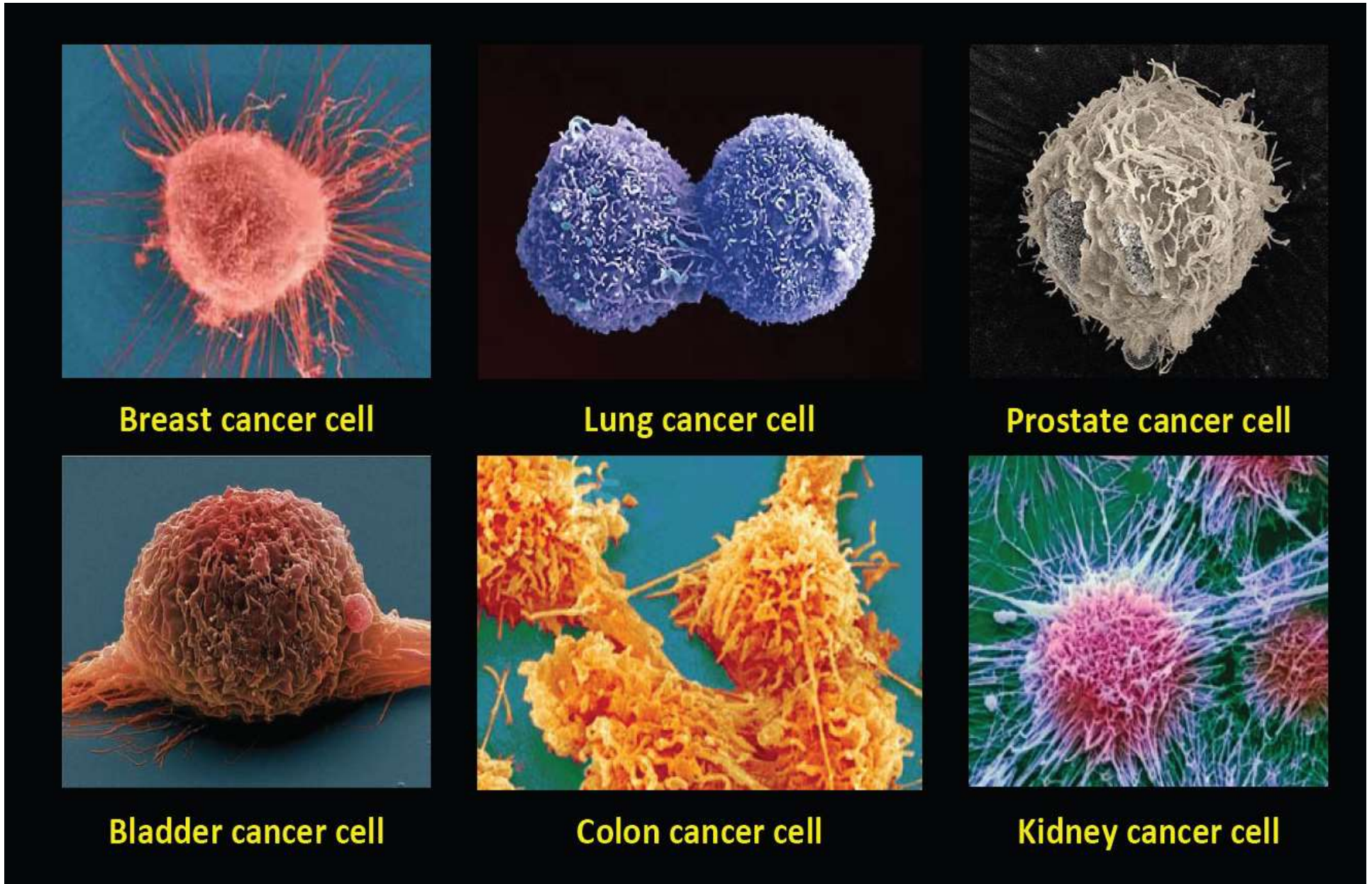
利用特異性抗體分離循環腫瘤細胞



利用特異性抗體分離循環腫瘤細胞

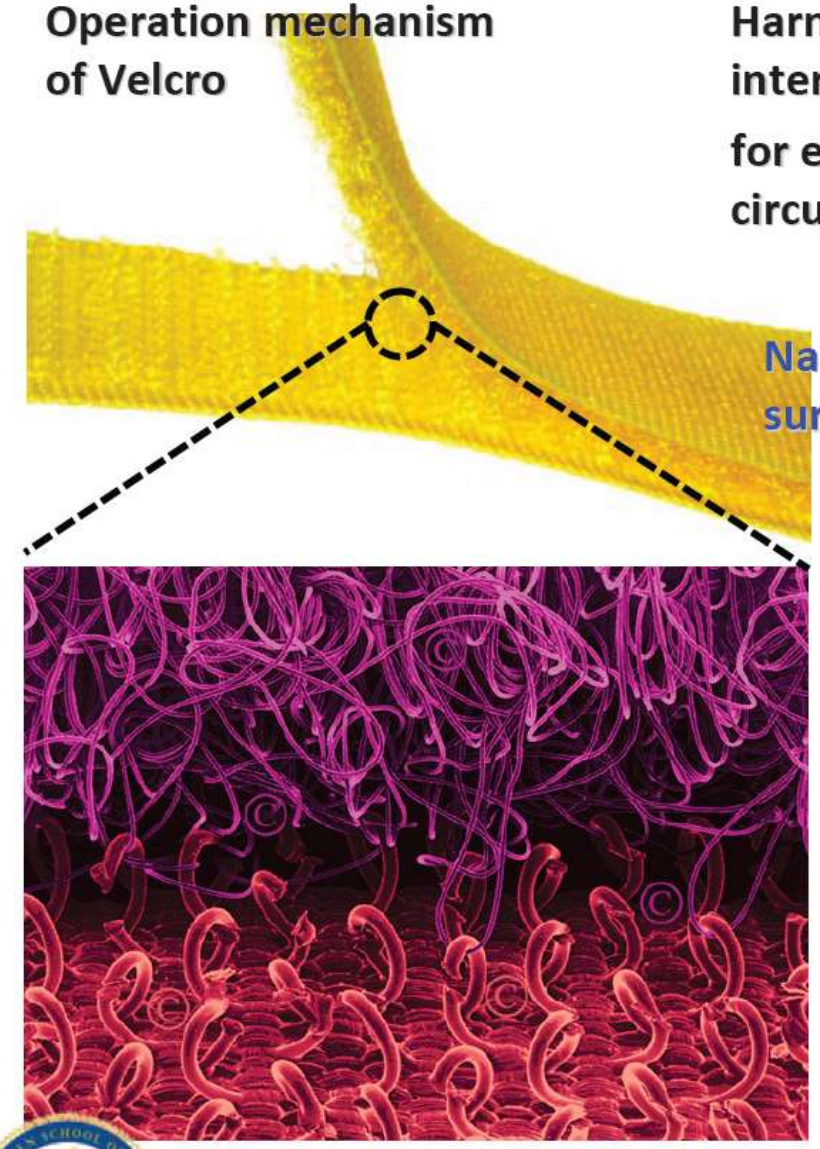


利用物理接觸分離循環腫瘤細胞



利用物理接觸分離循環腫瘤細胞

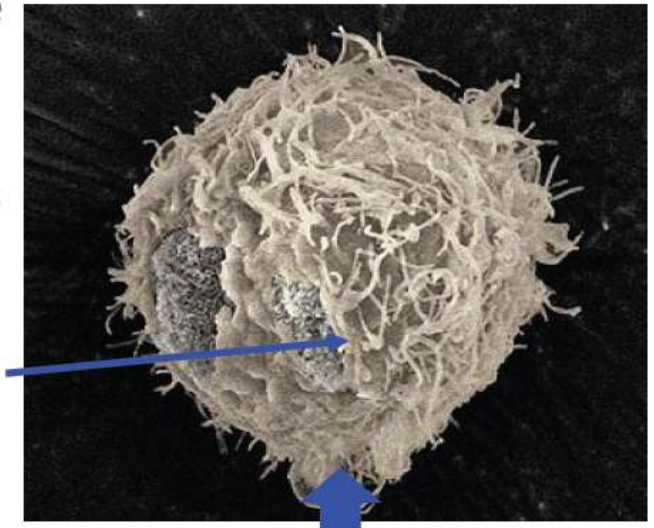
Operation mechanism of Velcro

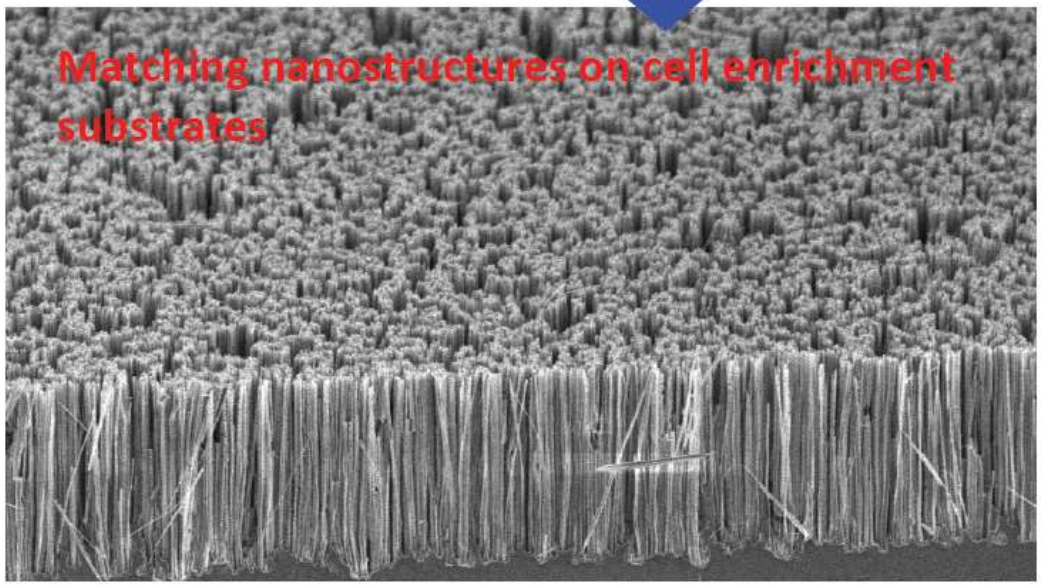


Harnessing Velcro-like interactions

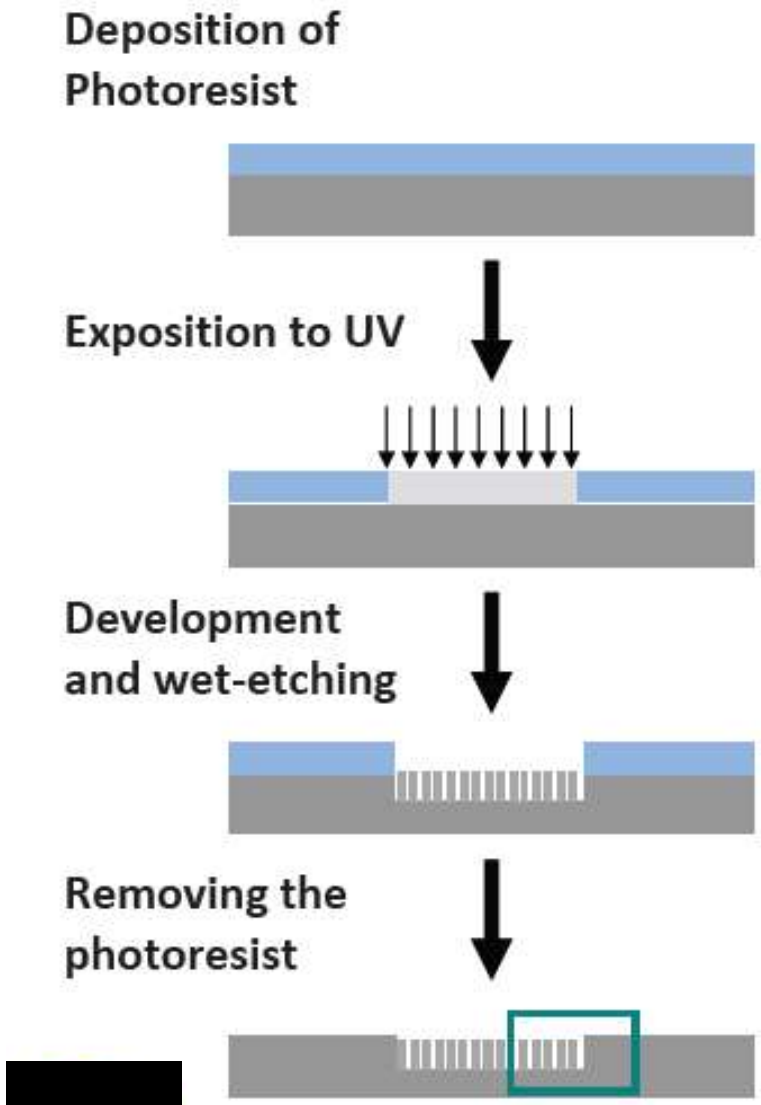
for enrichment of circulating tumor cells

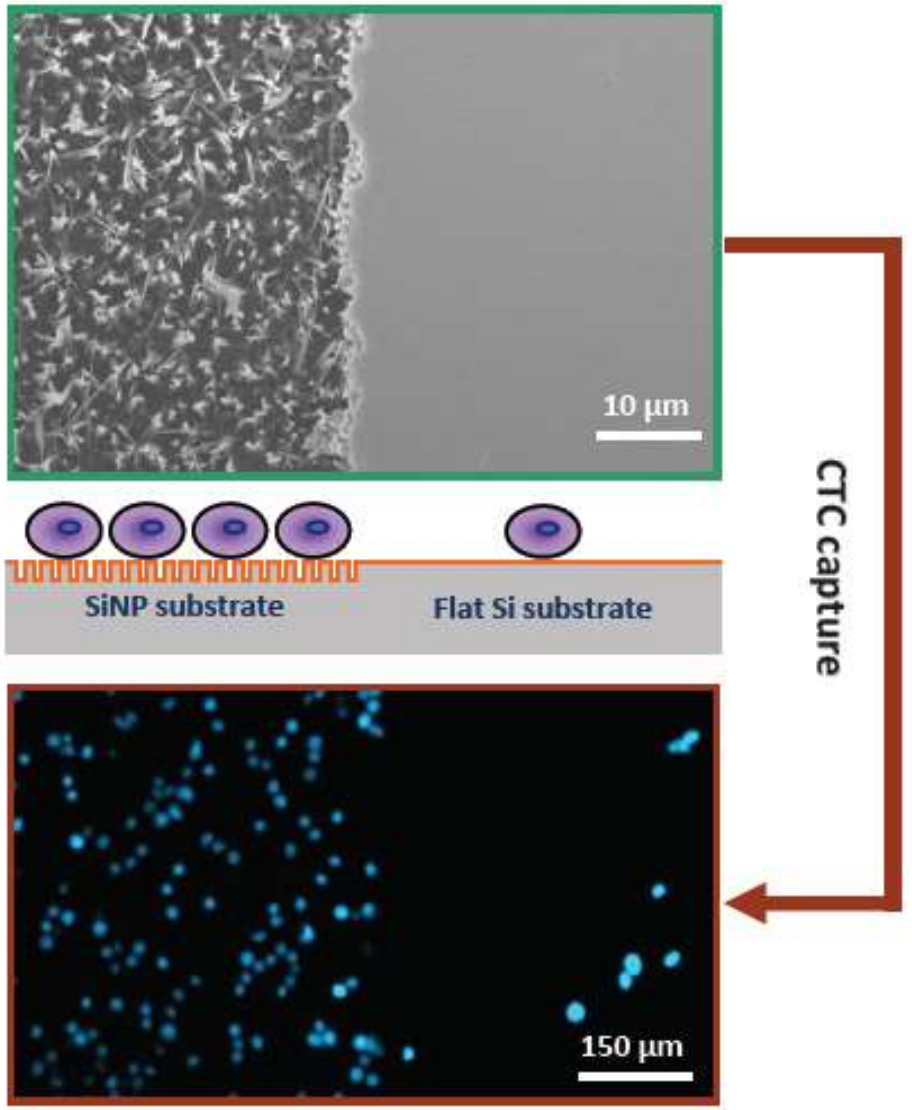
Nanostructured cell surface components





利用物理接觸分離循環腫瘤細胞





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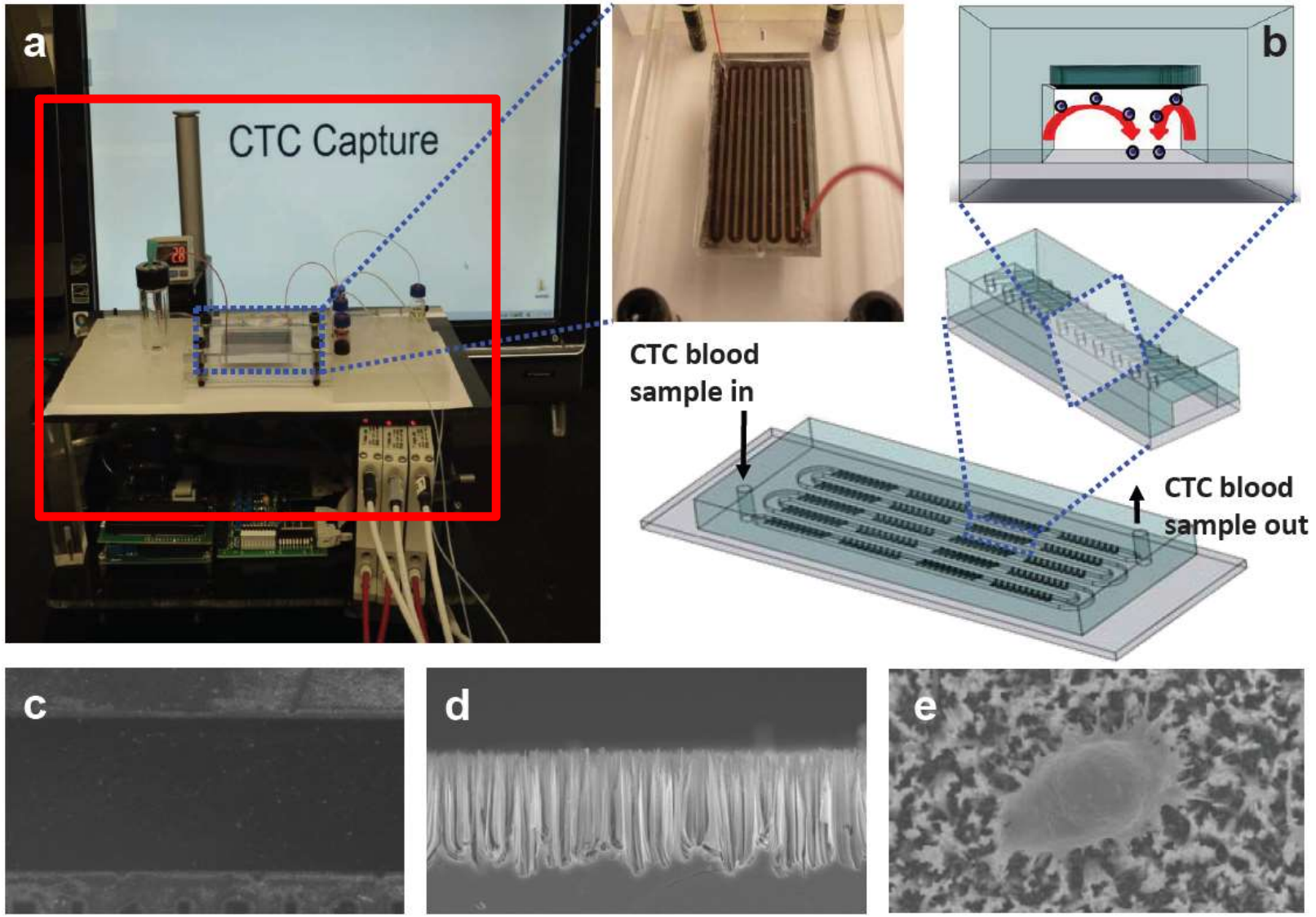
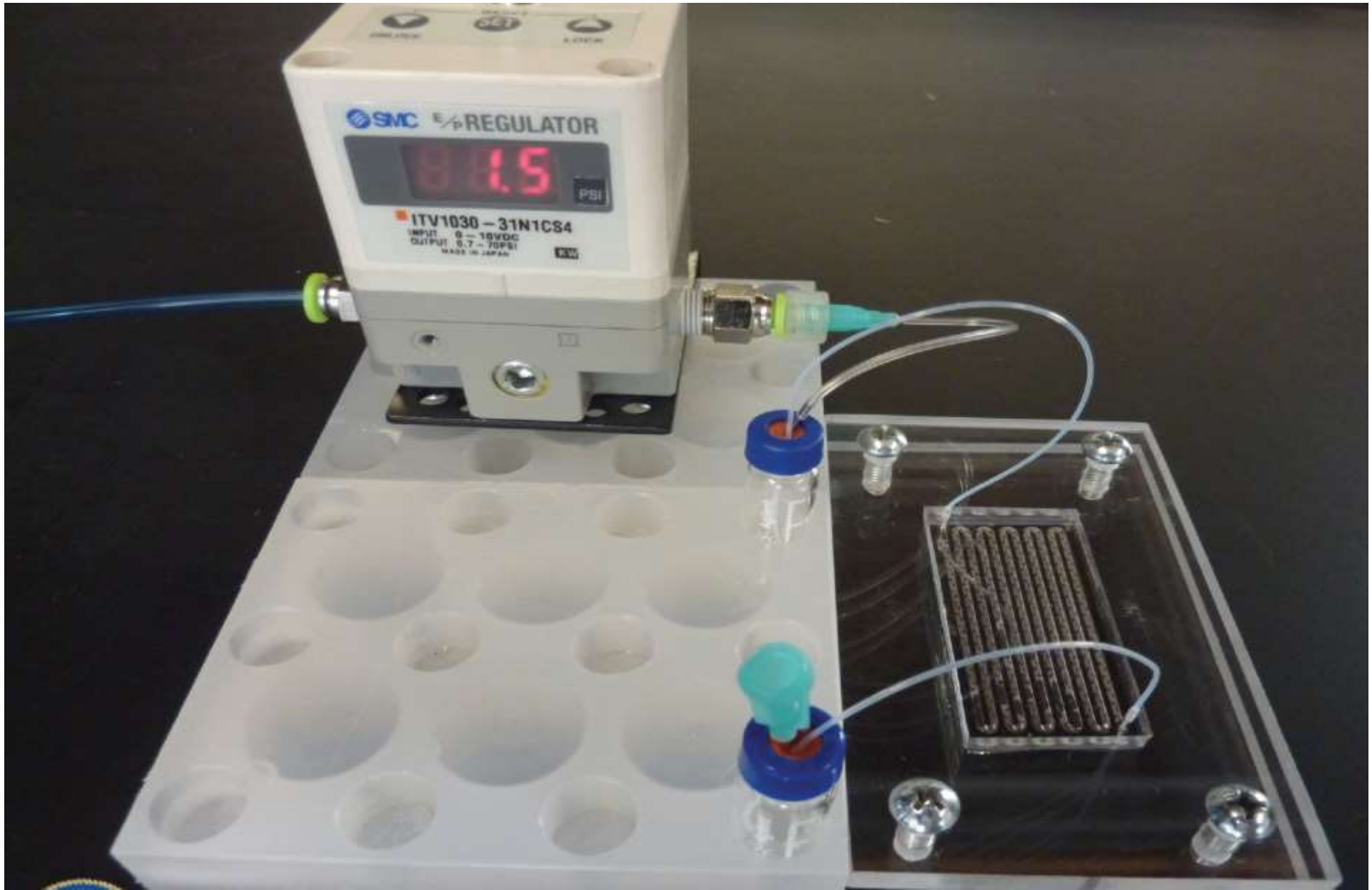
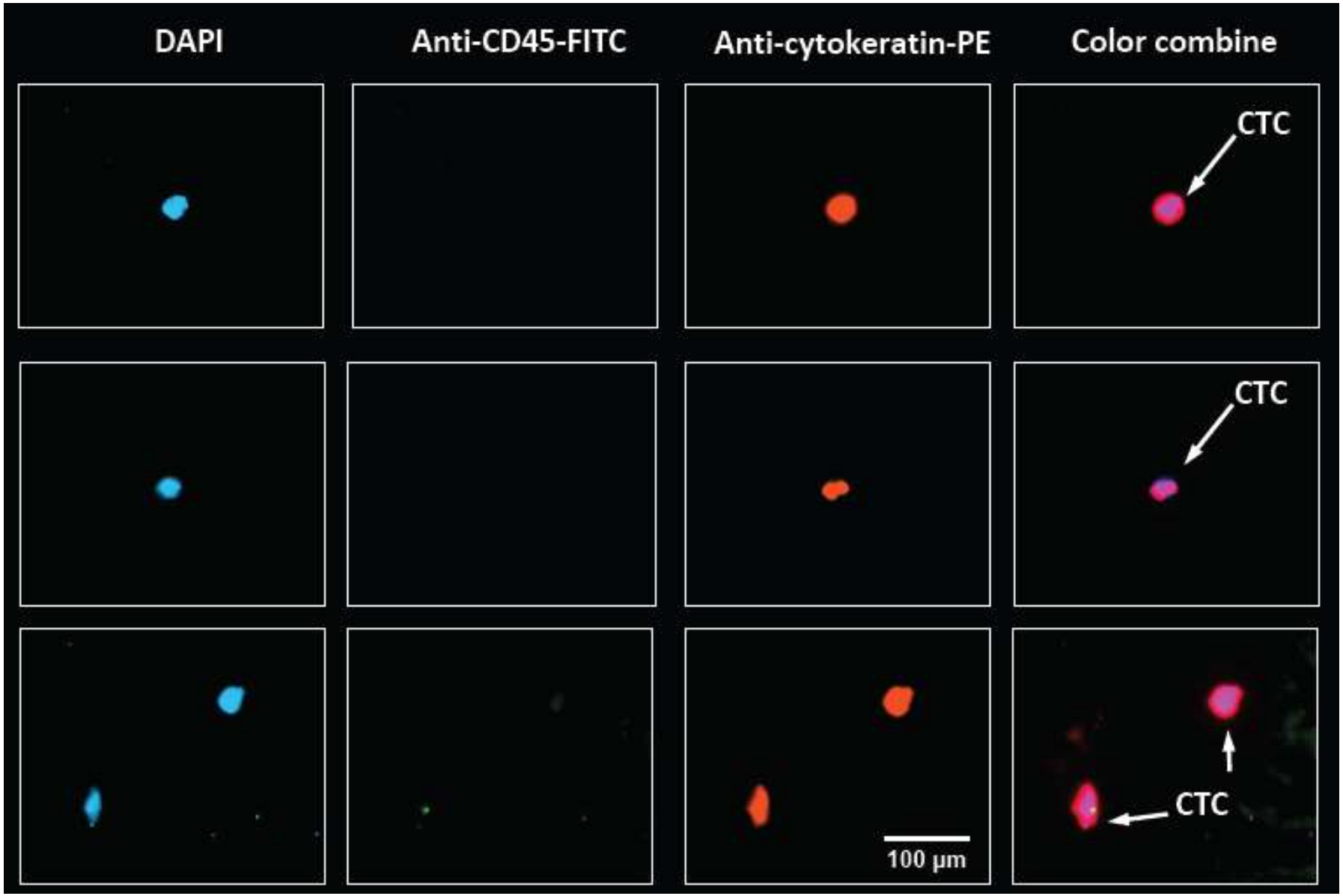


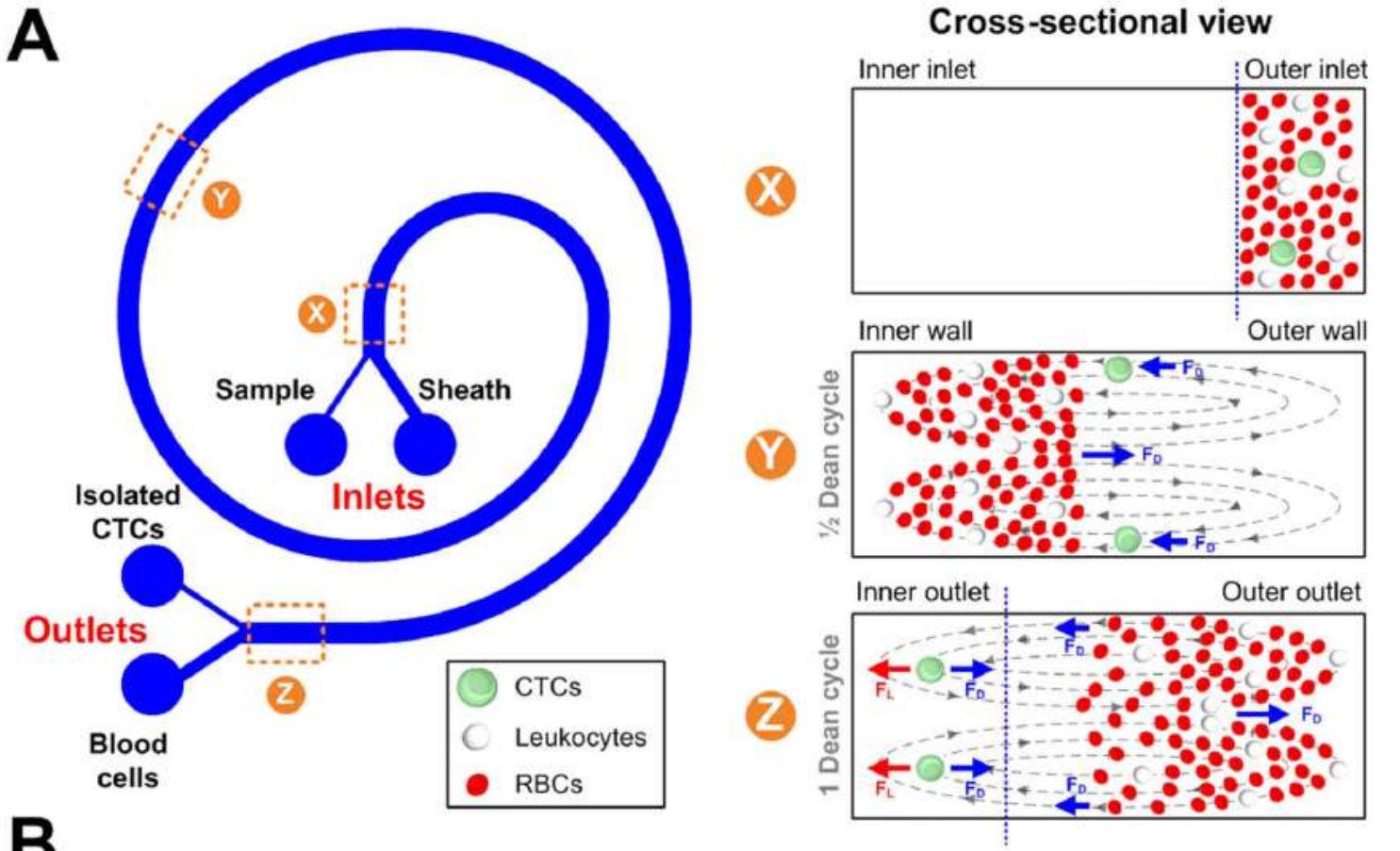
利用物理接觸分離循環腫瘤細胞



確認循環腫瘤細胞


DAPI
Anti-CD45-FITC
Anti-cytokeratin-PE
Color combine
CTC
CTC
CTC
100 μm

循環腫瘤細胞分離



Scientific Reports volume 3, Article number: 1259 (2013)

循環腫瘤細胞分離

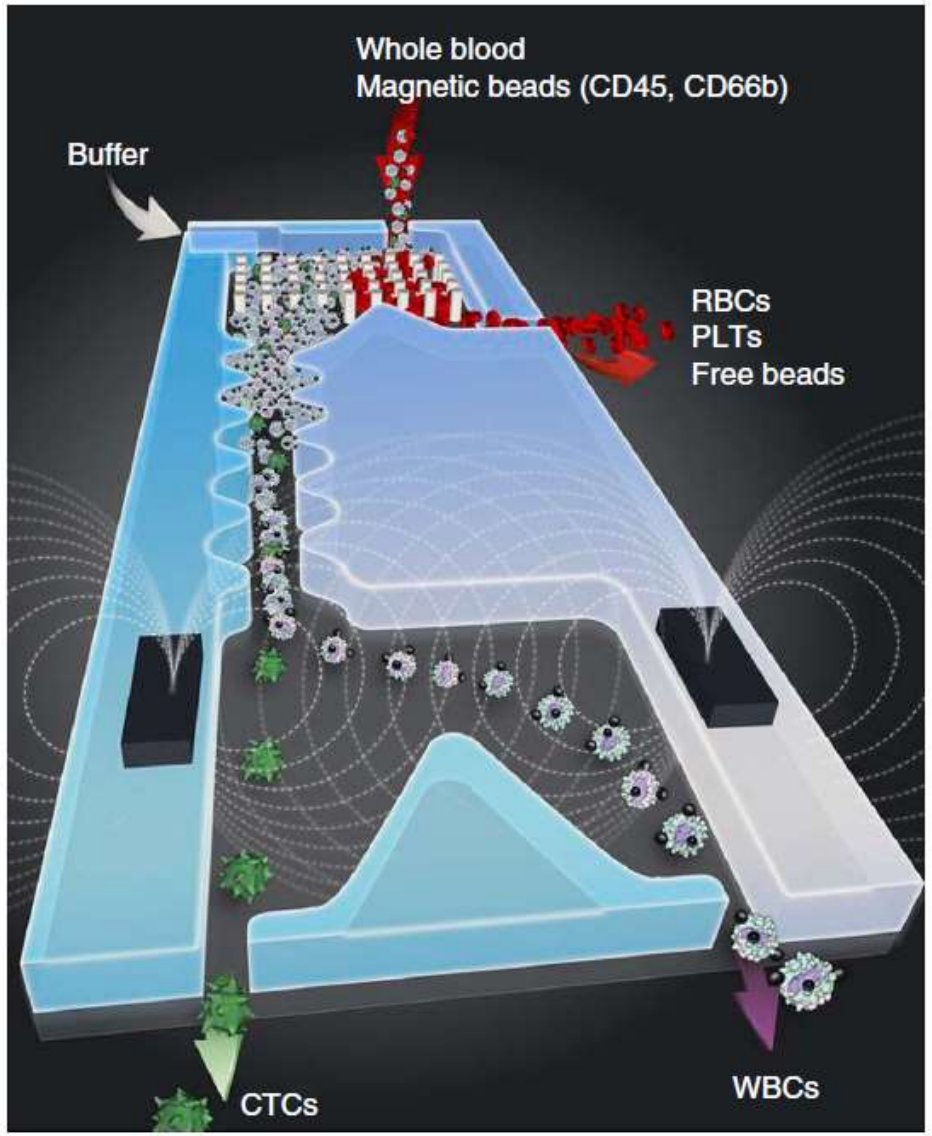
PROTOCOL

Microfluidic, marker-free isolation of circulating tumor cells from blood samples

Nezihi Murat Karabacak[1,4], Philipp S Spuhler[1,4], Fabio Fachin[1], Eugene J Lim[1], Vincent Pai[1], Emre Ozkumur[1], Joseph M Martel[1], Nikola Kojic[1], Kyle Smith[1], Pin-i Chen[1], Jennifer Yang[1], Henry Hwang[1], Bailey Morgan[1], Julie Trautwein[2], Thomas A Barber[1], Shannon L Stott[1,2], Shyamala Maheswaran[2], Ravi Kapur[1], Daniel A Haber[2,3] & Mehmet Toner[1]

Module 1:
CTC-iChip1
(deterministic lateral displacement)

Module 2:
CTC-iChip2
(inertial focusing and magnetophoresis)



循環腫瘤細胞分離

Lab on a Chip

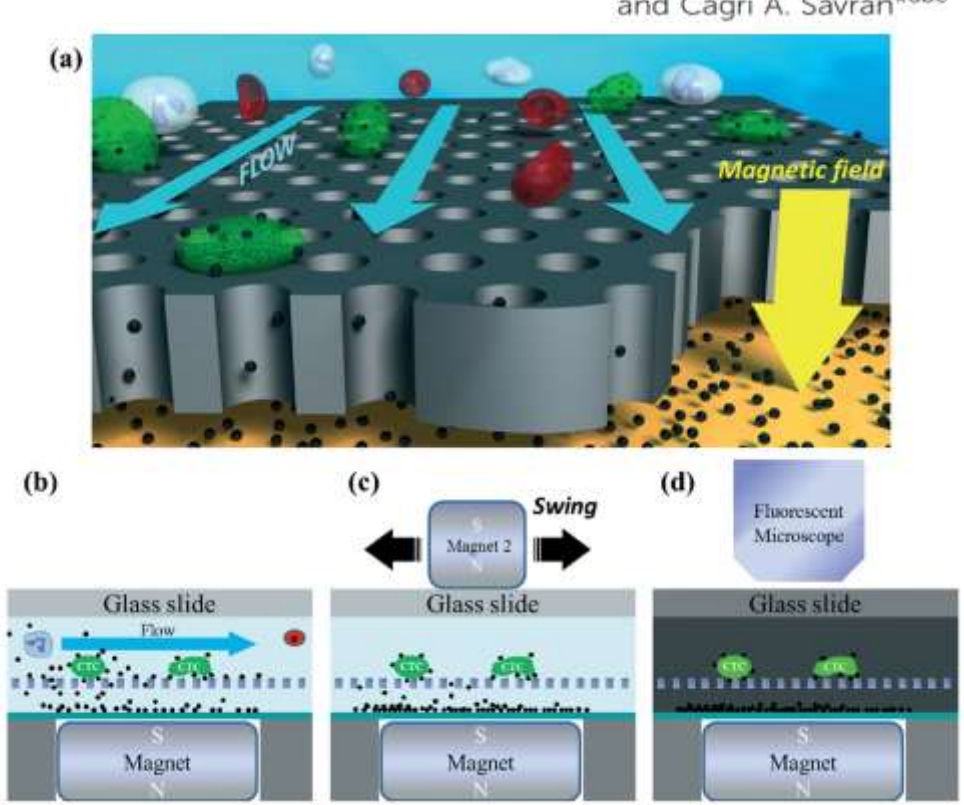
PAPER

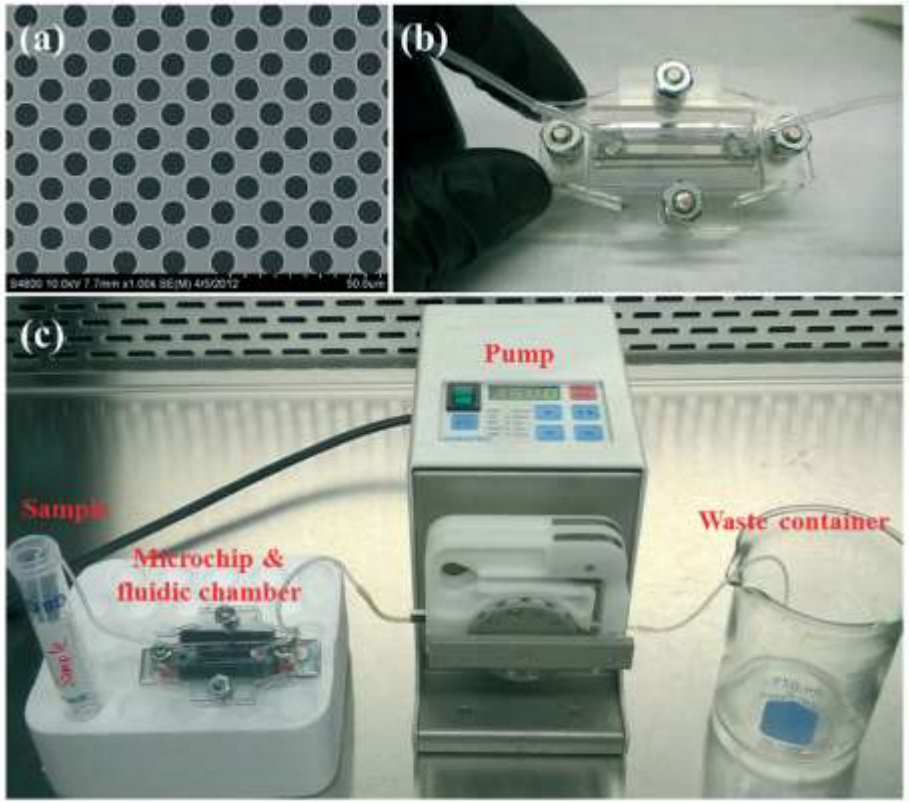
View Article Online
View Journal | View Issue

Circulating tumor cell detection using a parallel flow micro-aperture chip system†

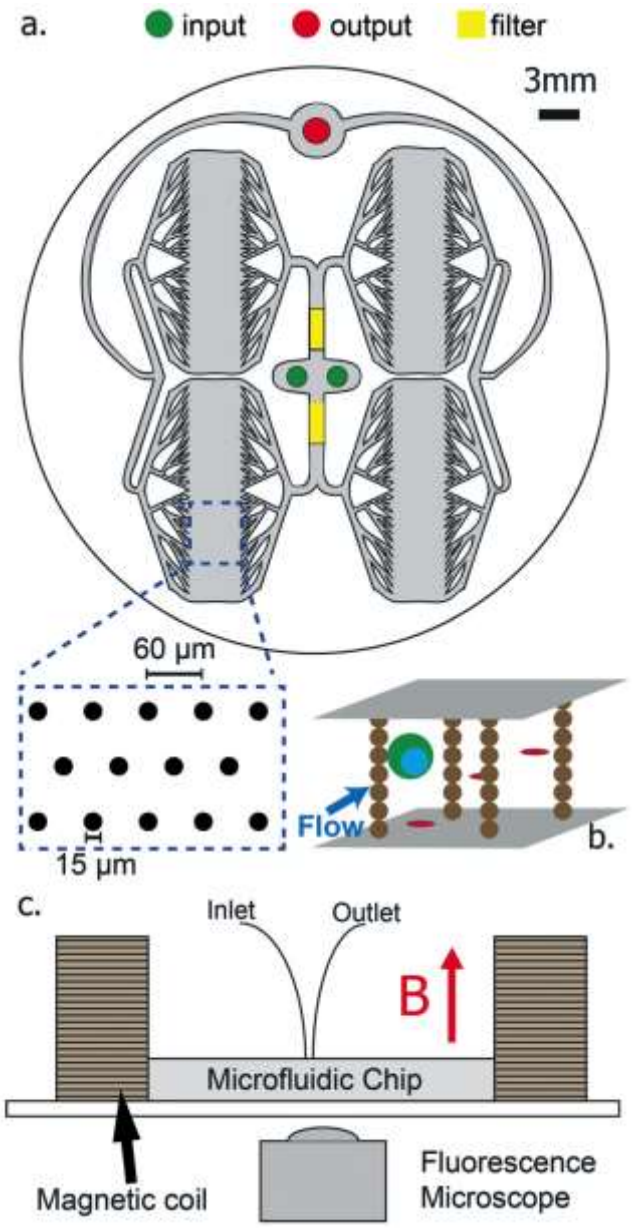
Chun-Li Chang,[ab] Wanfeng Huang,[ab] Shadia I. Jalal,[d] Bin-Da Chan,[ab] Aamer Mahmood,[b] Safi Shahda,[d] Bert H. O'Neil,[d] Daniela E. Matei[d] and Cagri A. Savran*[abc]

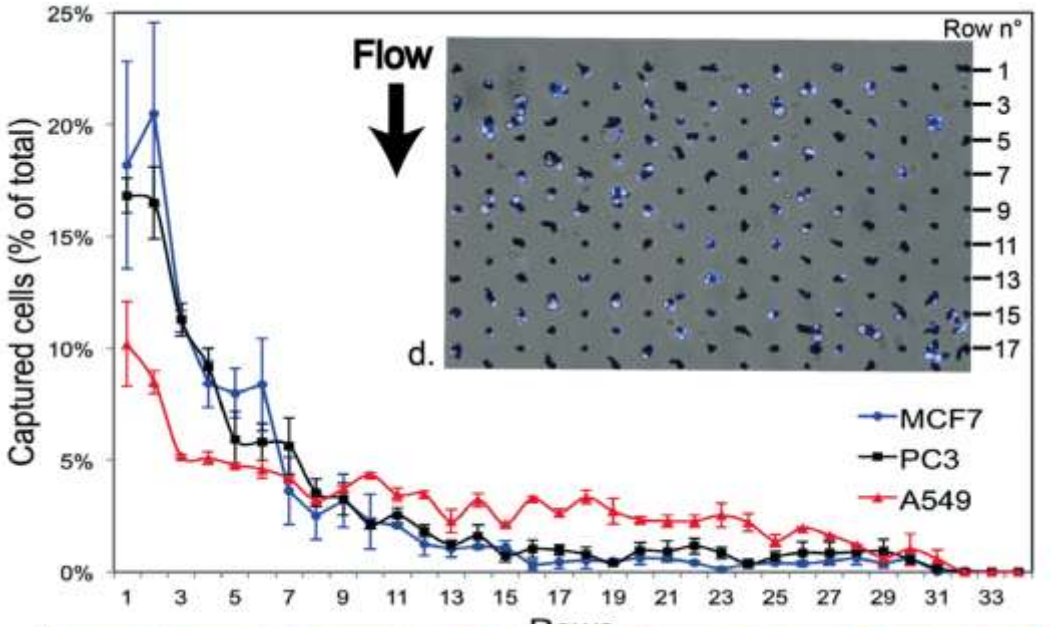
Cite this: *Lab Chip*, 2015, 15, 1677

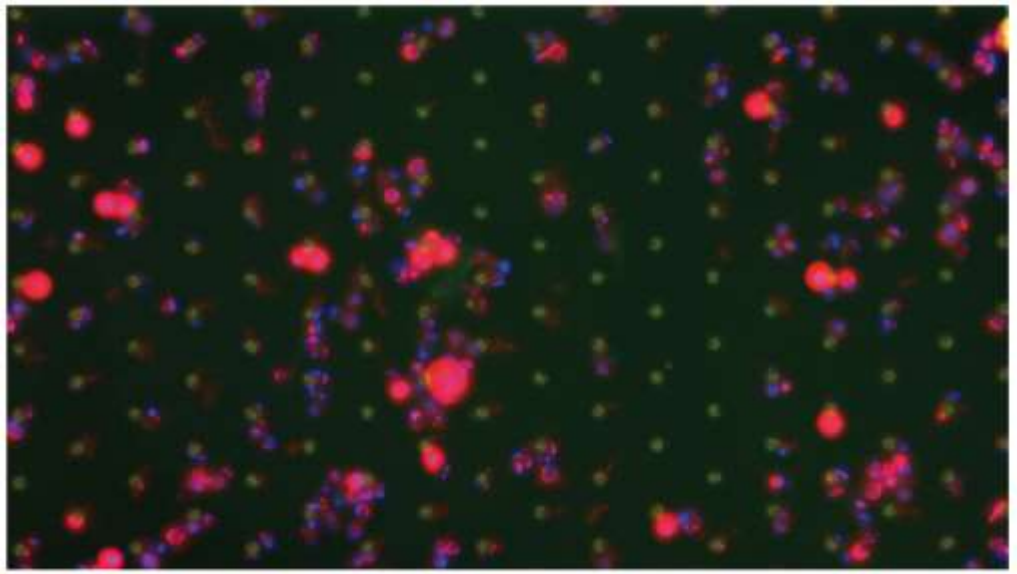


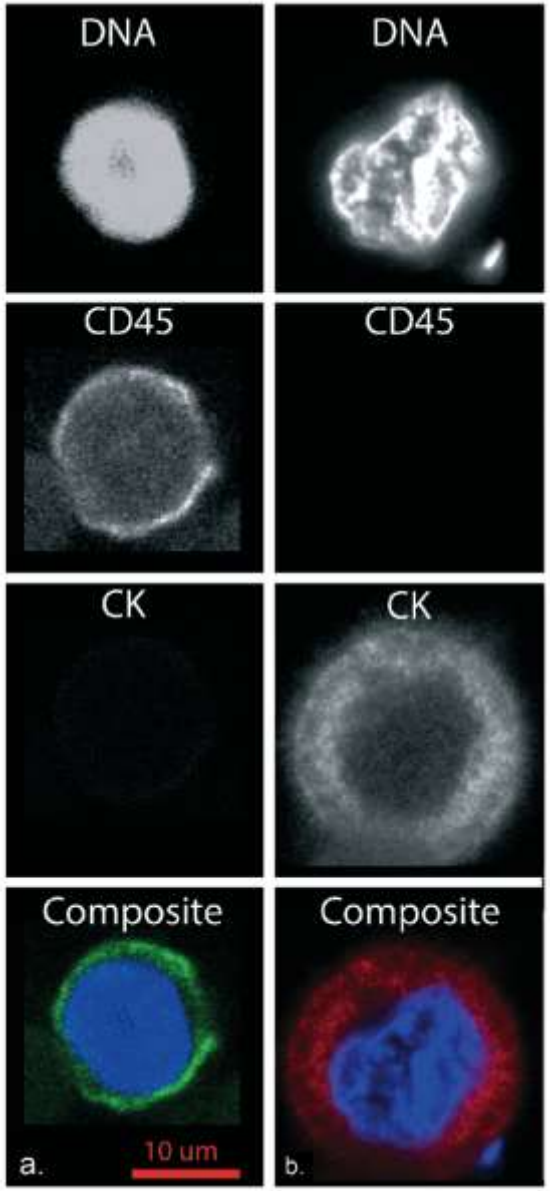


循環腫瘤細胞分離



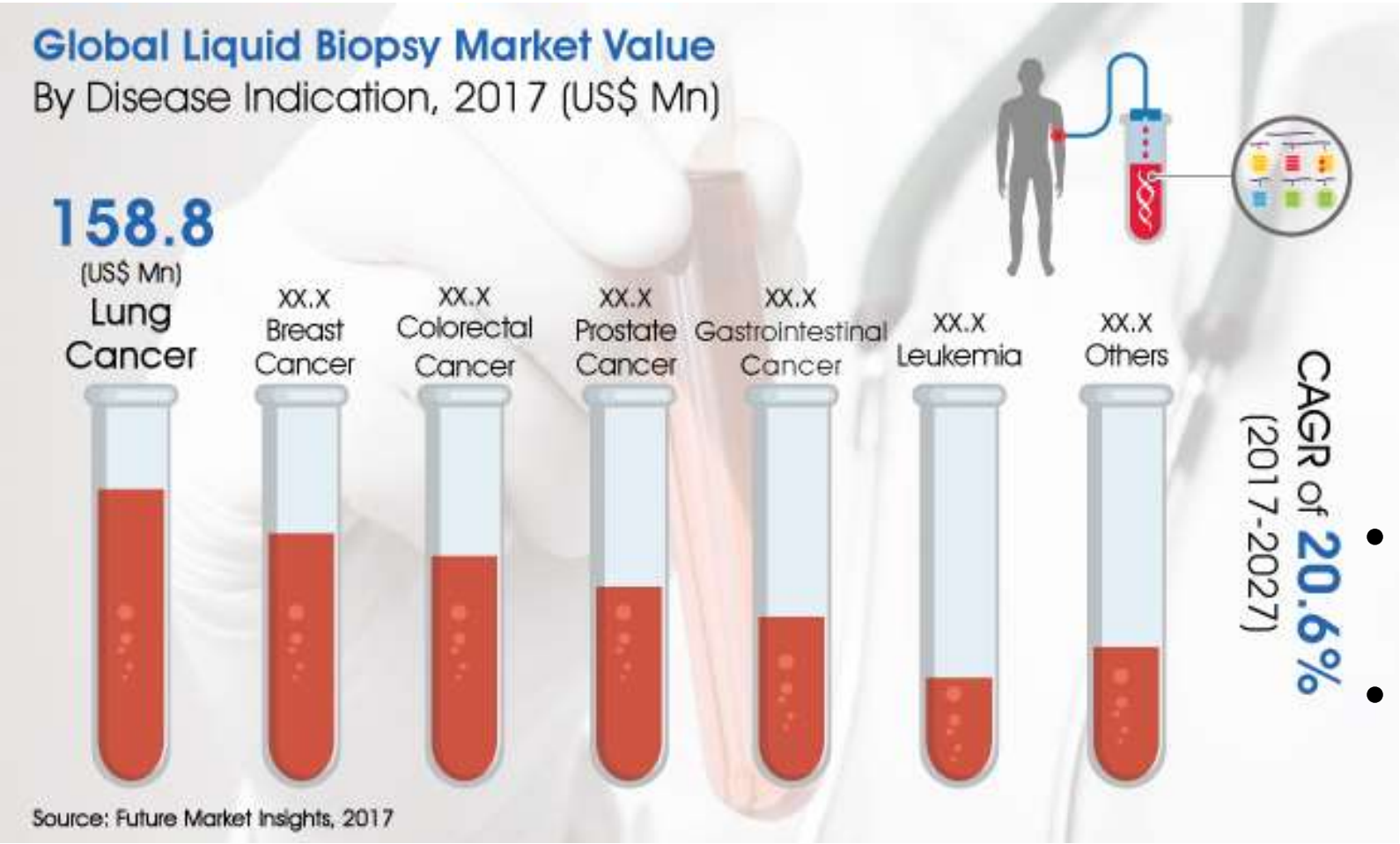






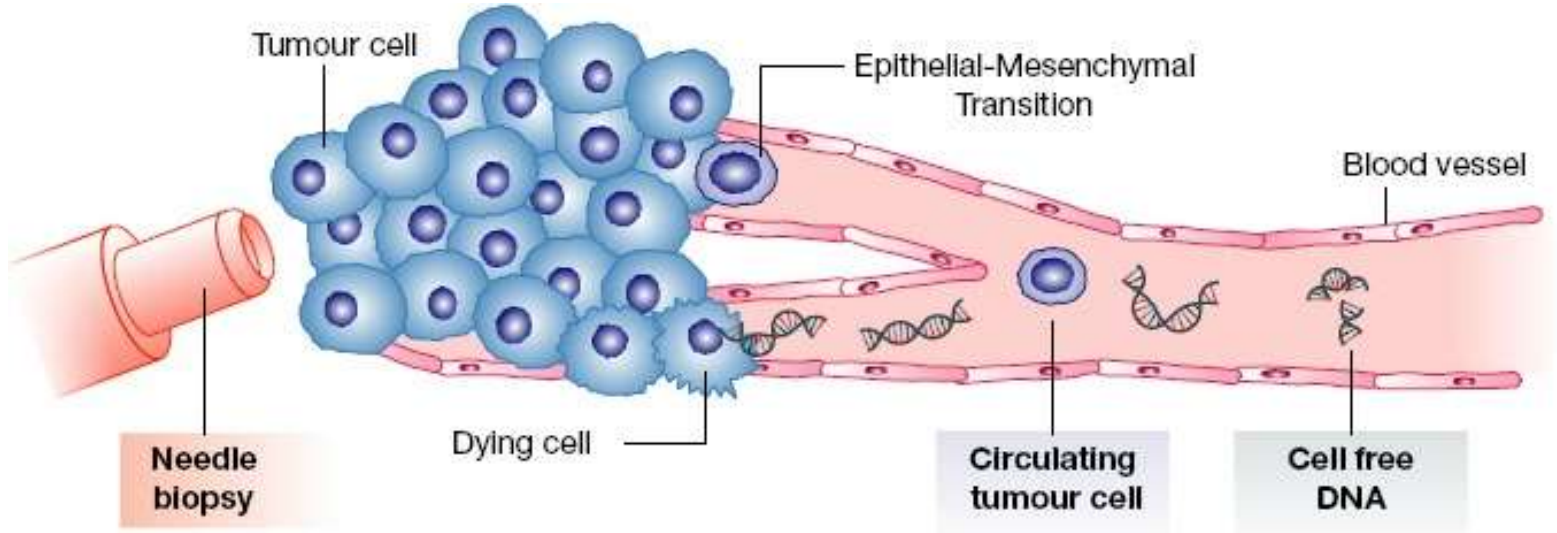
Lab Chip, 2015, 15, 2090–2101

液態檢體市場



- Global liquid biopsy market: US$ 456 M, 2017
- Estimated market at 2027: US$ 3,130.7 M

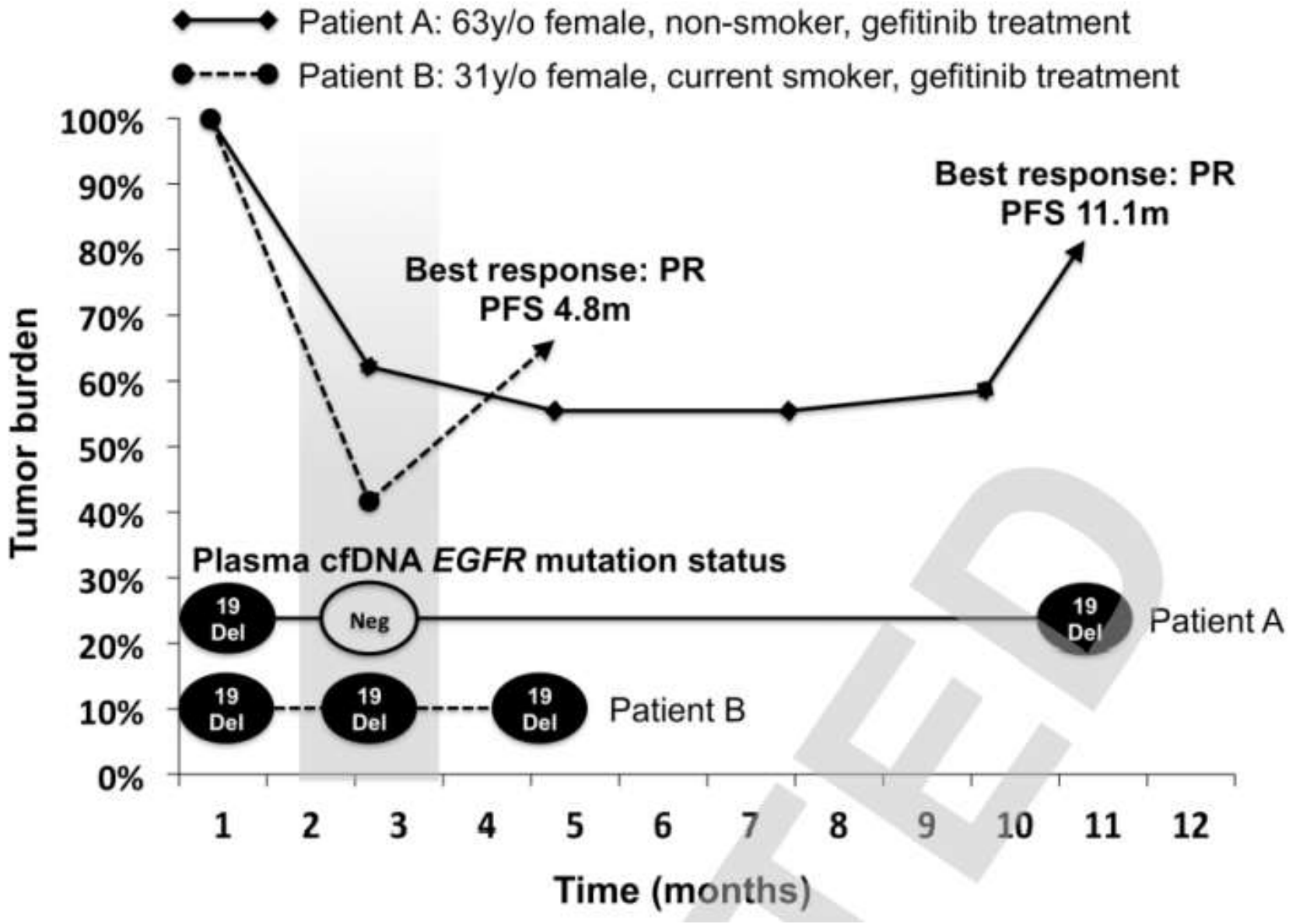
腫瘤組織、循環腫瘤、游離DNA



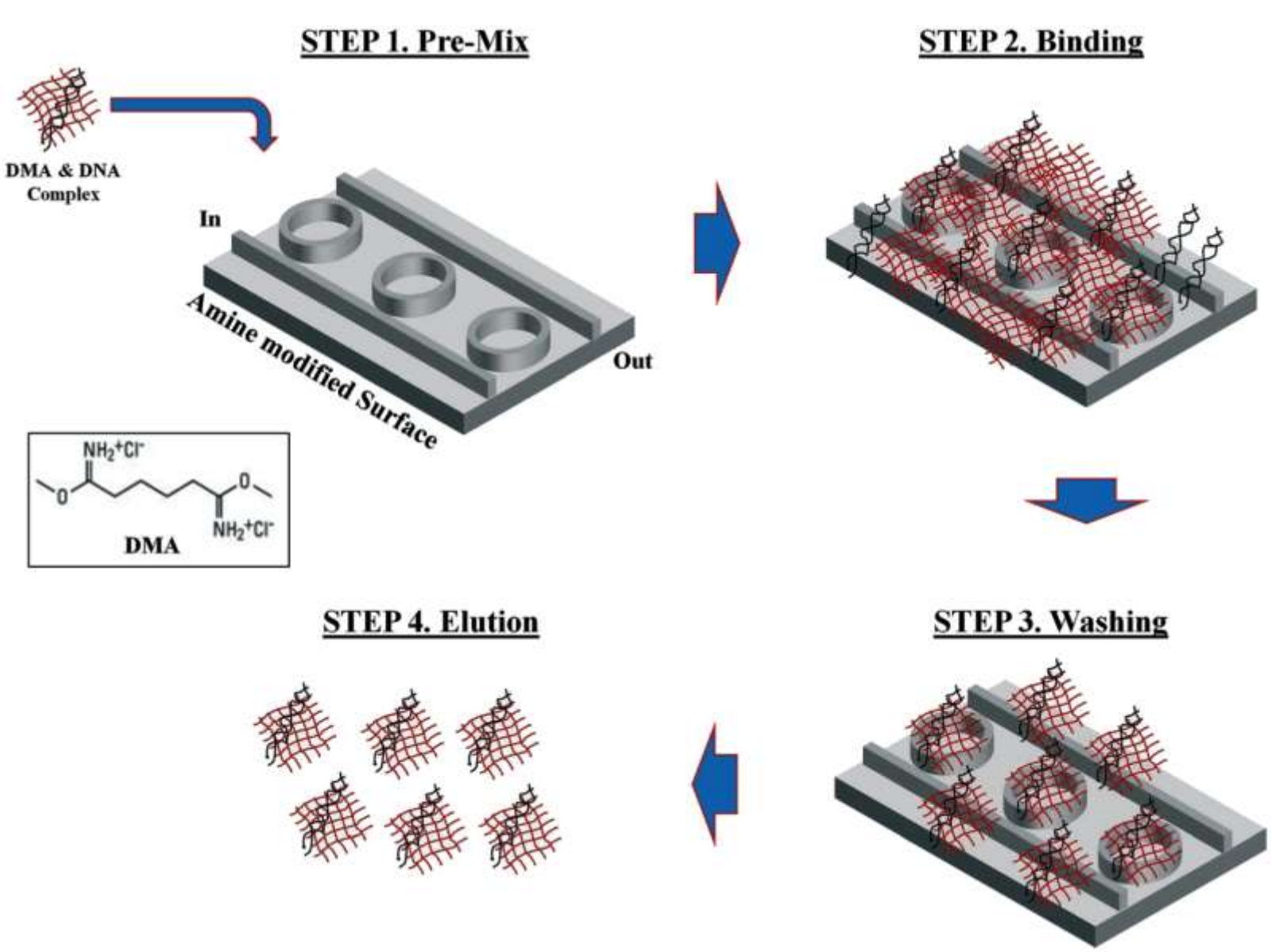
	Biopsy	CTC	cfDNA
Invasive	+	–	–
All patients eligible	–	+	+
Instrumentation required	+	+	–
WGA required	–	+	+/–
RNA profiling	+	+	–
Research applicability	+++	++	+
Biomarker applicability	–	++	+++

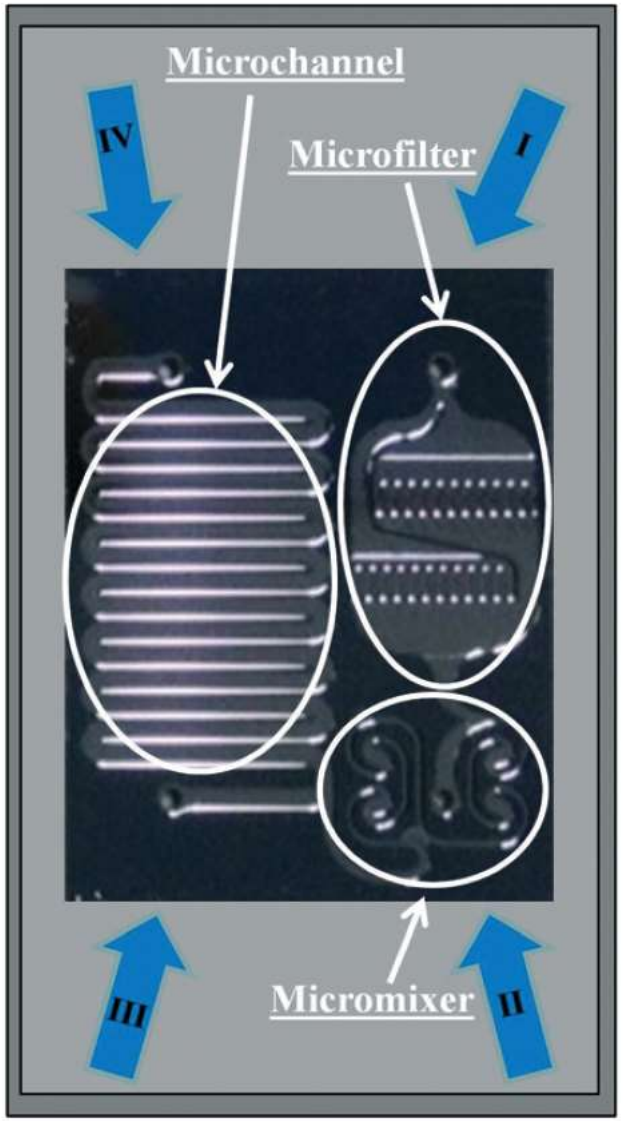
Transl Cancer Res 2015; 4(3): 280-290

利用游離DNA監控病程發展



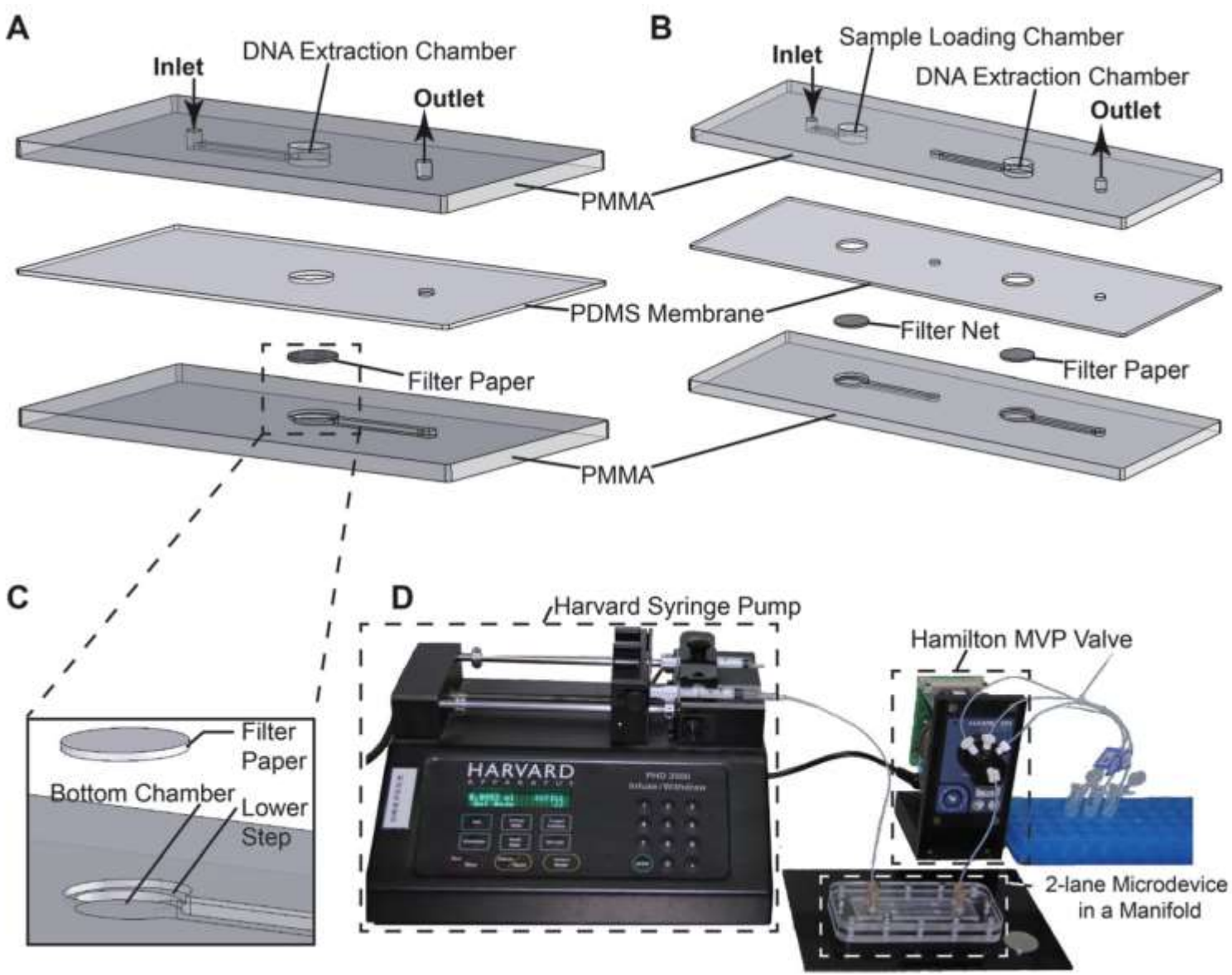
利用DMA與晶片萃取體液中微量DNA

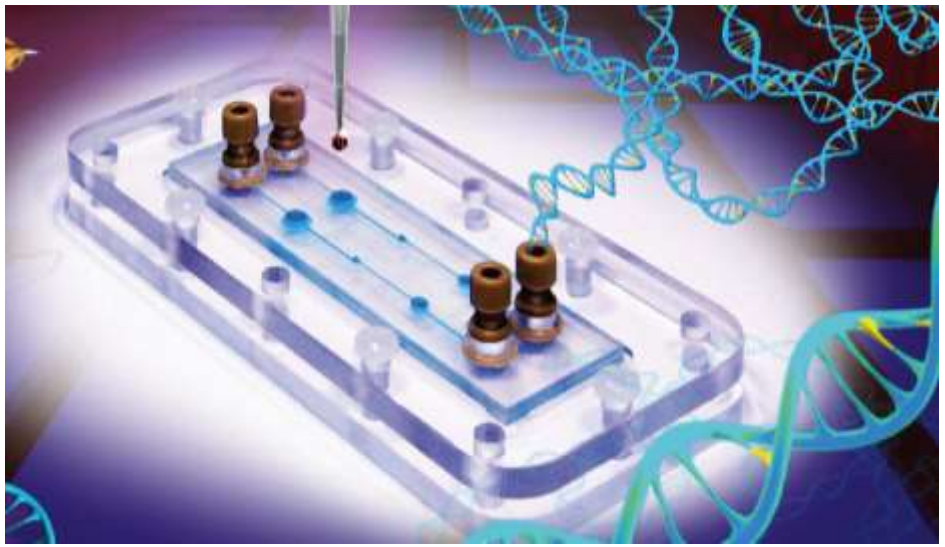


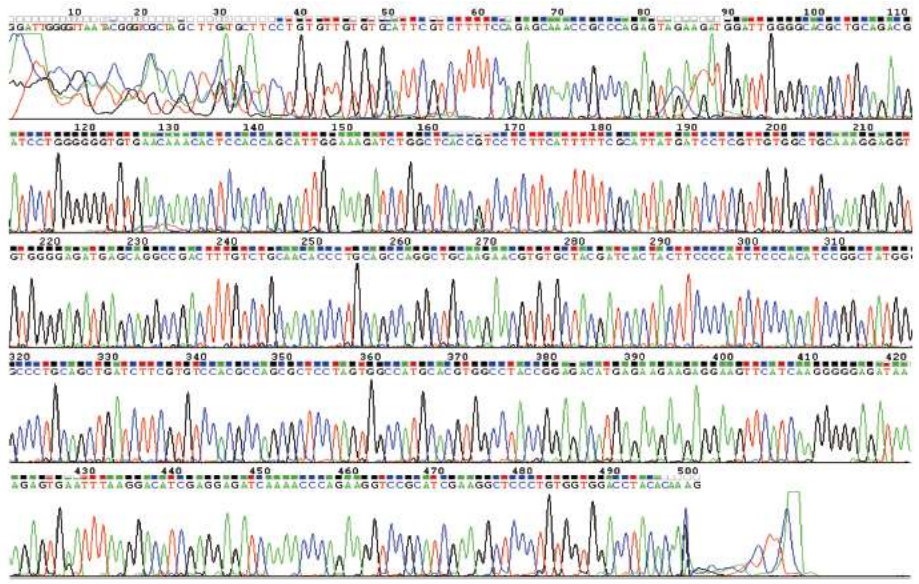


Lab Chip, 2014, 14, 359–368

利用濾紙與晶片萃取多種樣本DNA

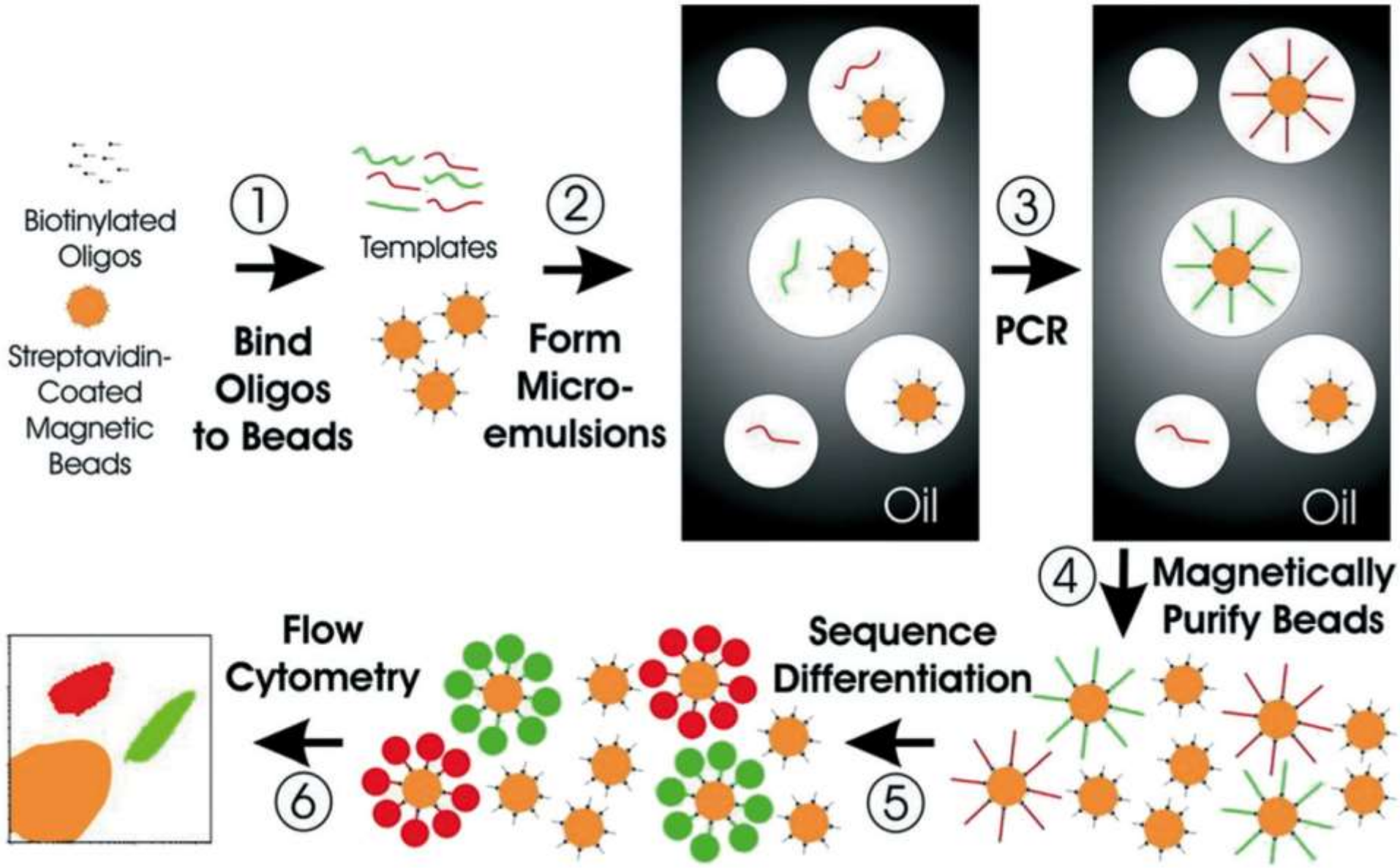






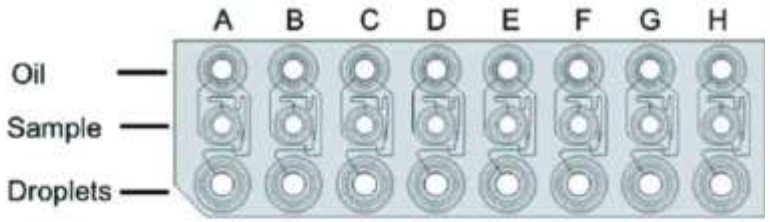
Lab Chip, 2014, 14, 3719-3728

BEAMing (Beads, Emulsion, Amplification, Magnetics)
檢測游離DNA突變

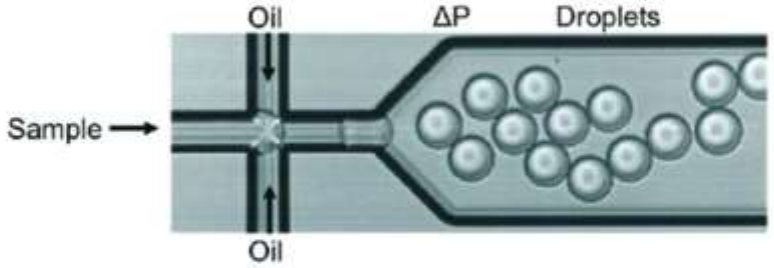


利用數位化PCR檢測基因突變

a Load samples and oil into disposable droplet generator cartridge



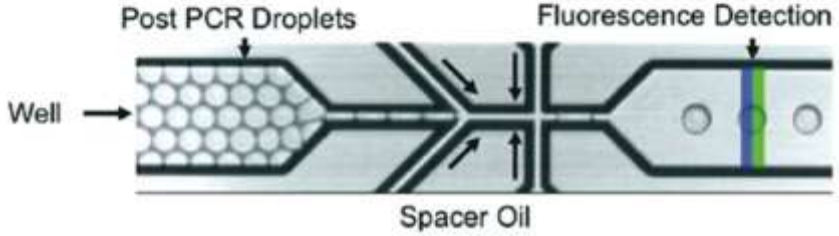
b Generate droplets

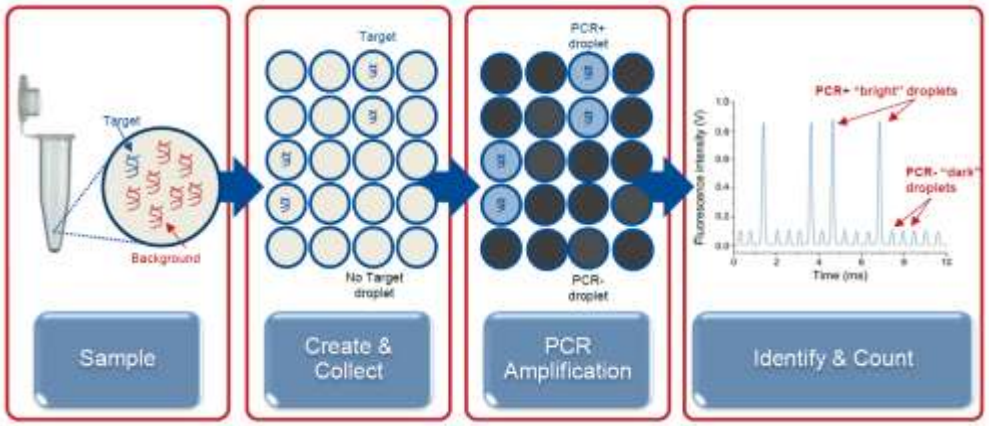


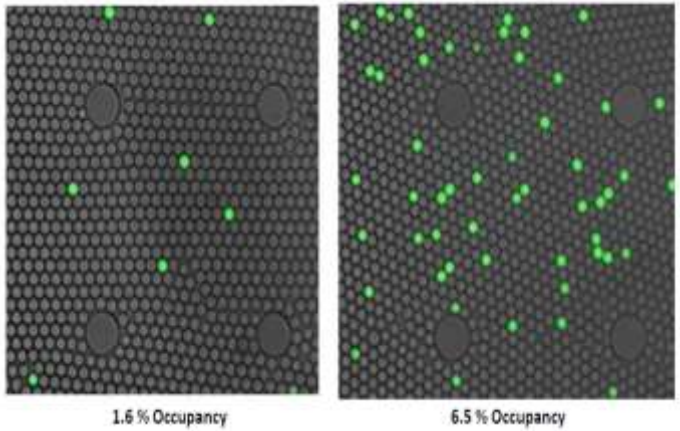
c Transfer droplets to 96-well PCR plate

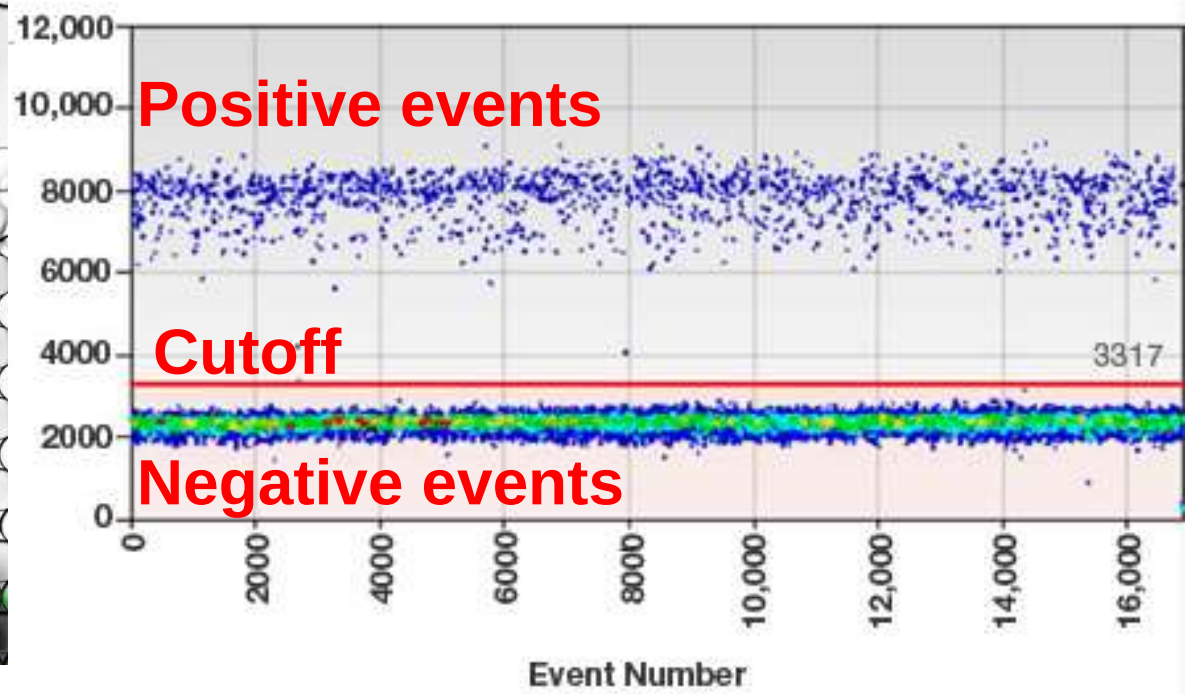
d Thermal cycle to end-point

e Read droplet fluorescence

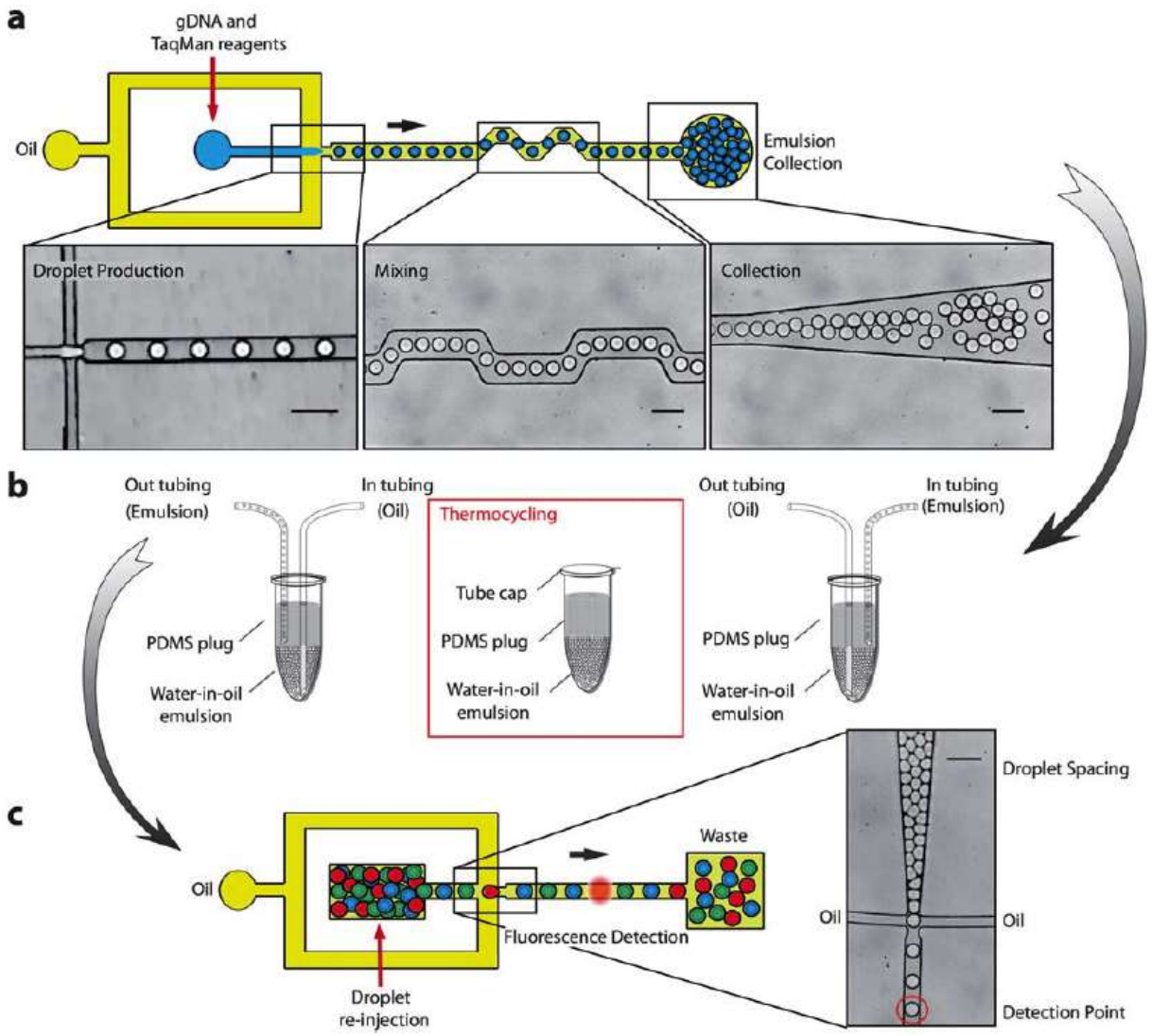


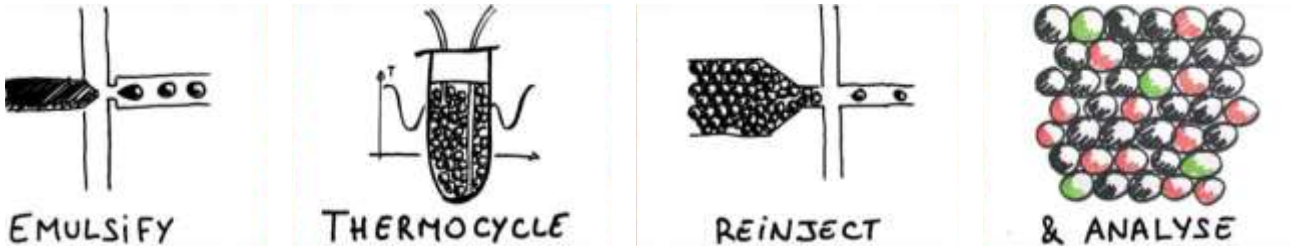


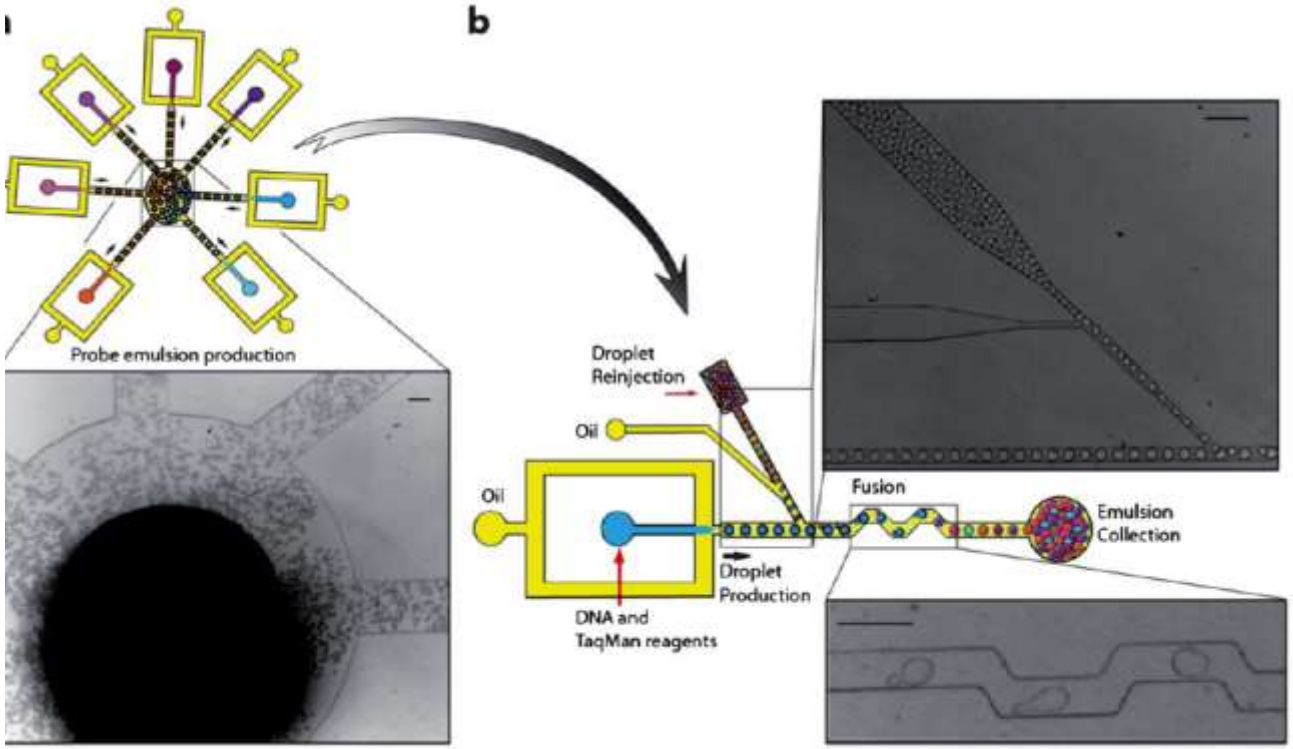




利用數位化PCR檢測基因突變

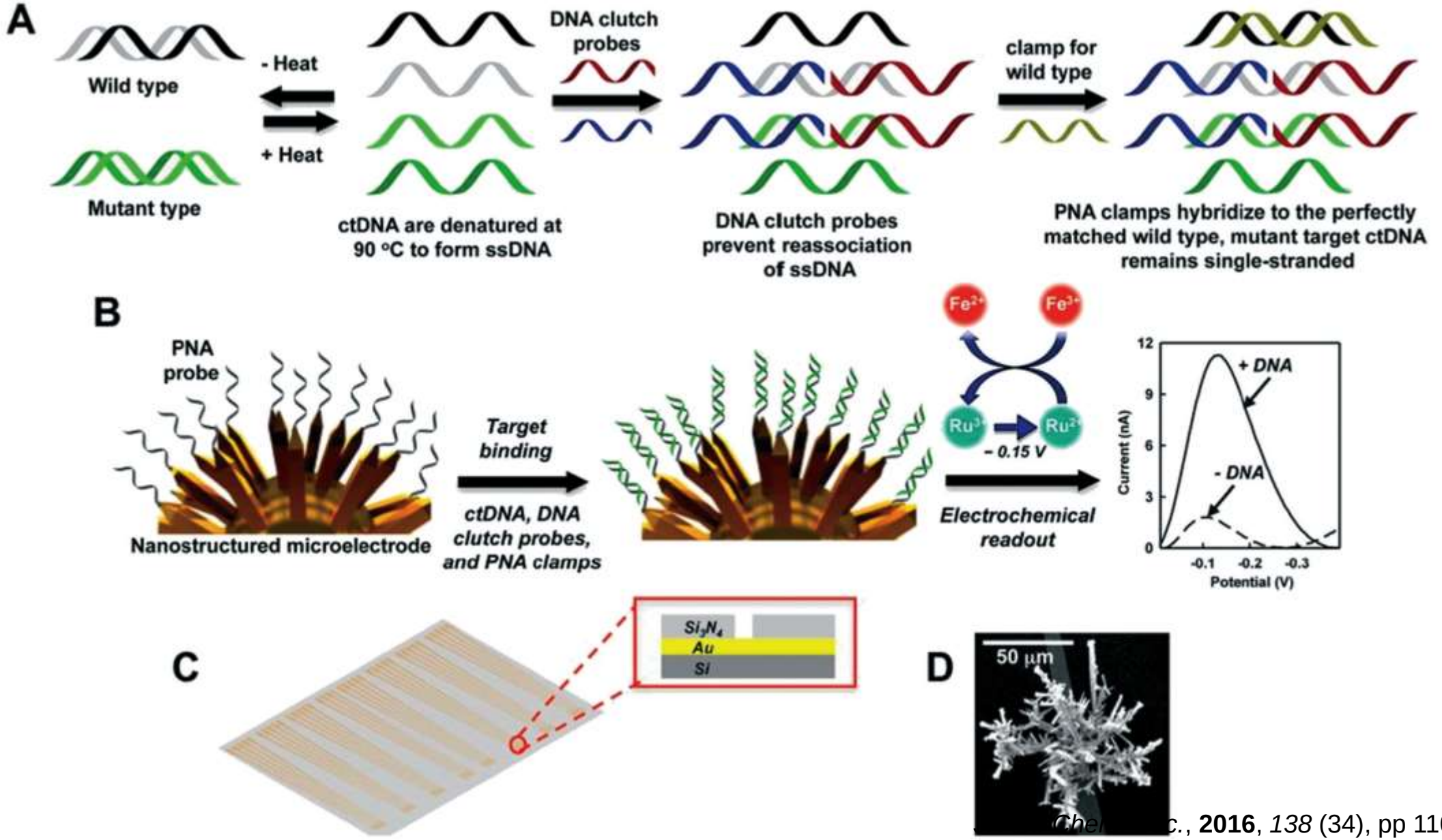






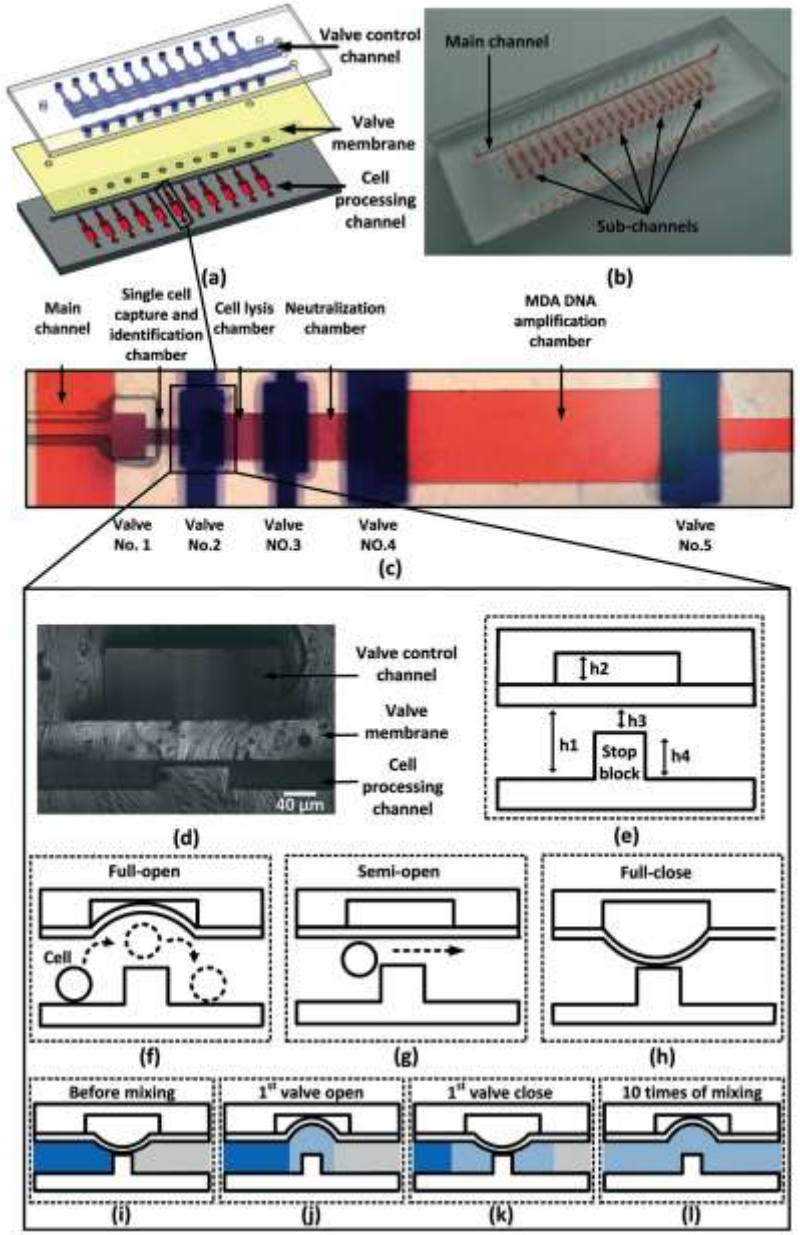
Lab Chip, 2011, 11, 2156–2166

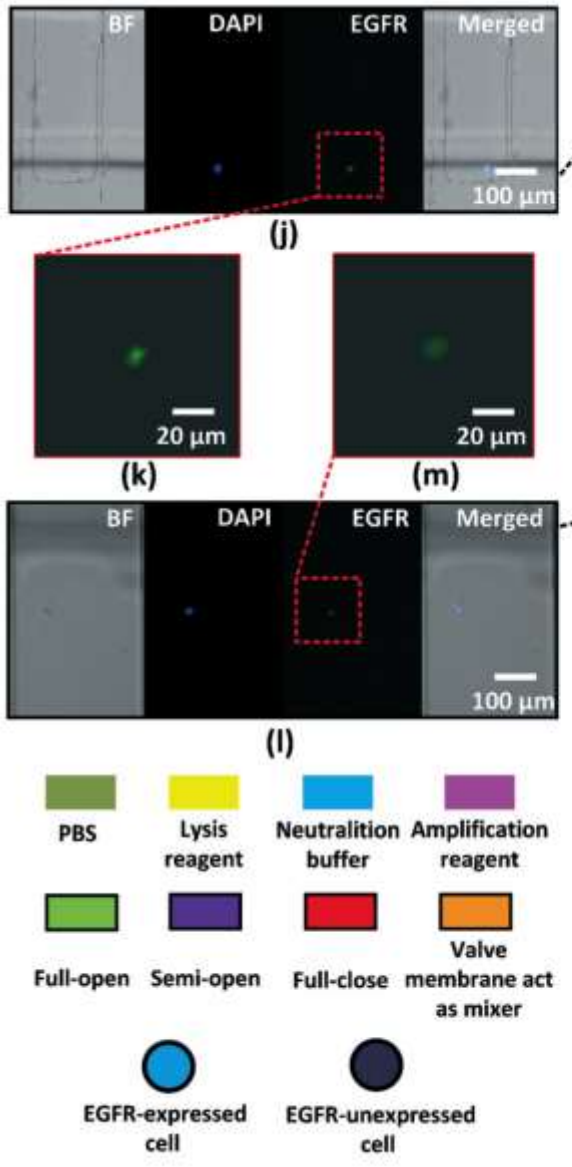
利用奈米結構微電極檢測血液中突變

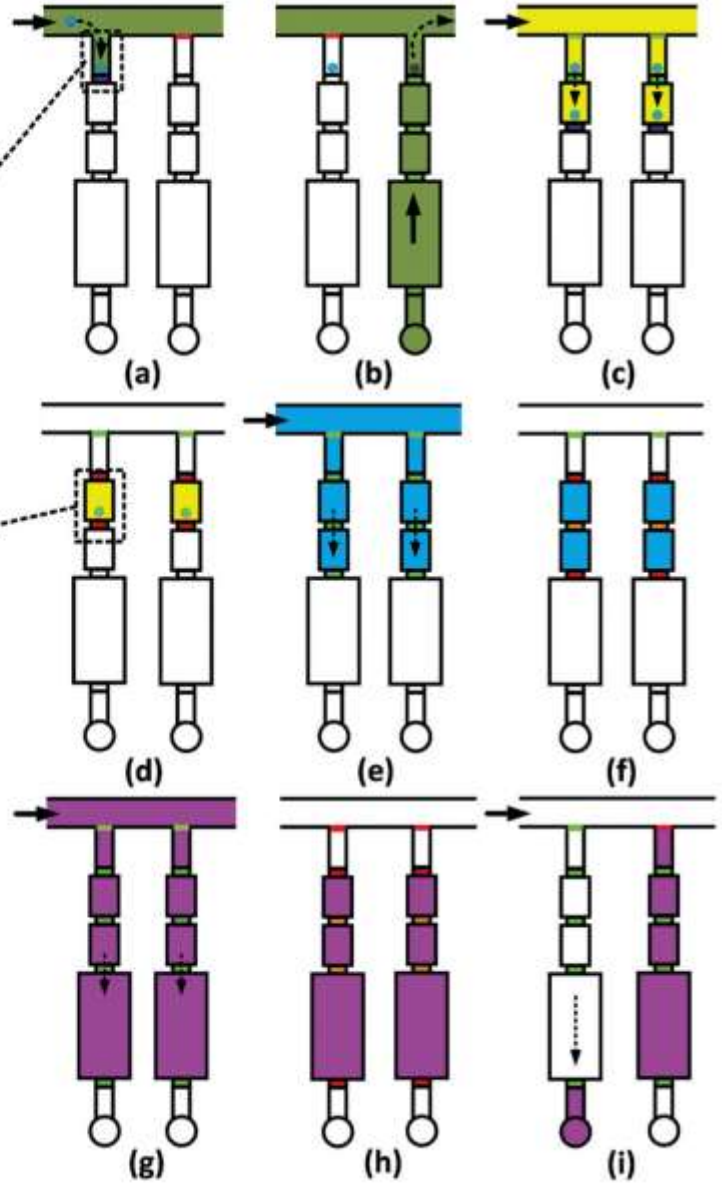


Chem. Soc., **2016**, *138* (34), pp 11009–11016

利用晶片分離單一細胞檢測突變

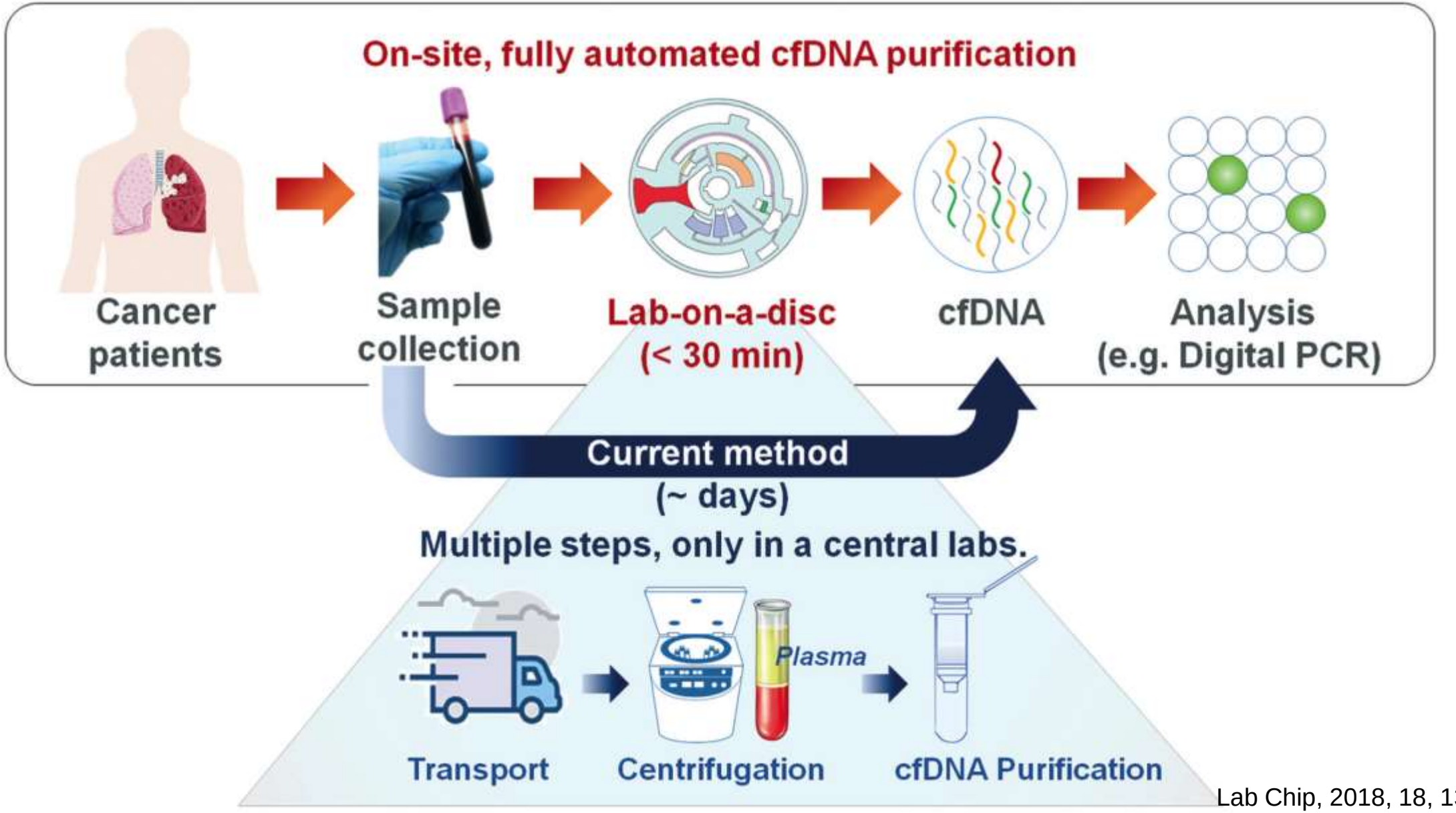






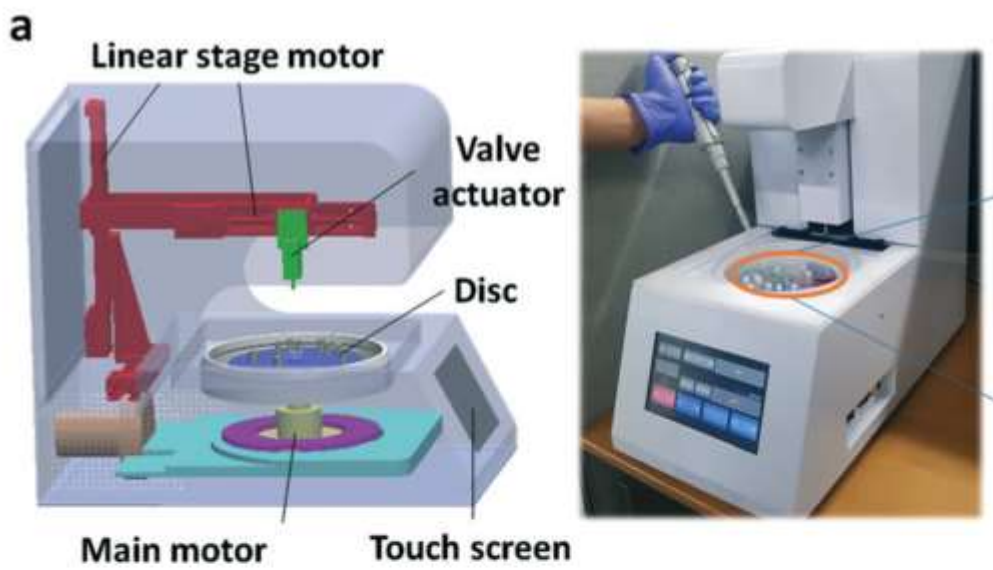
LabChip,2018,18,723–734

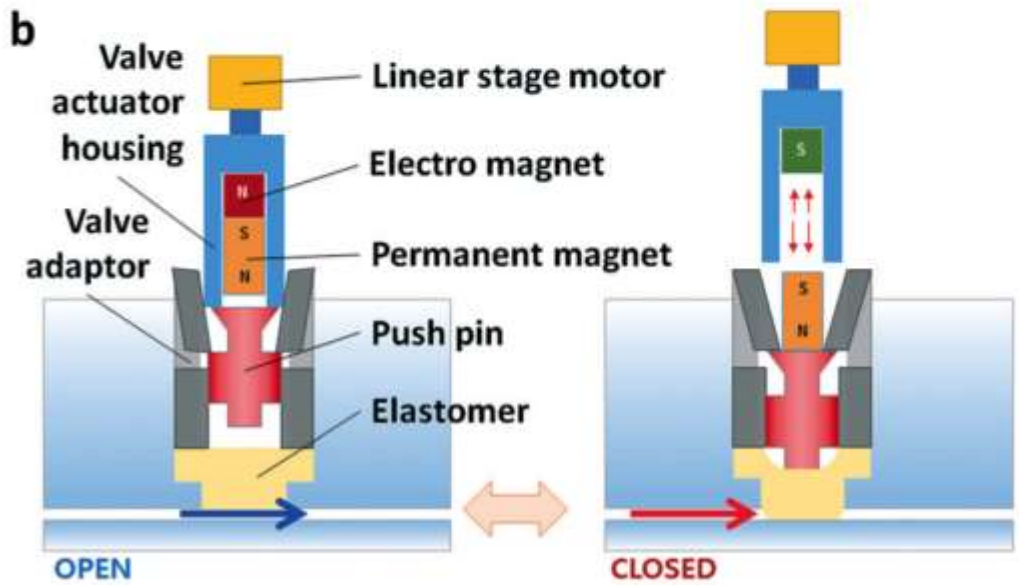
全自動血液游離DNA分離機

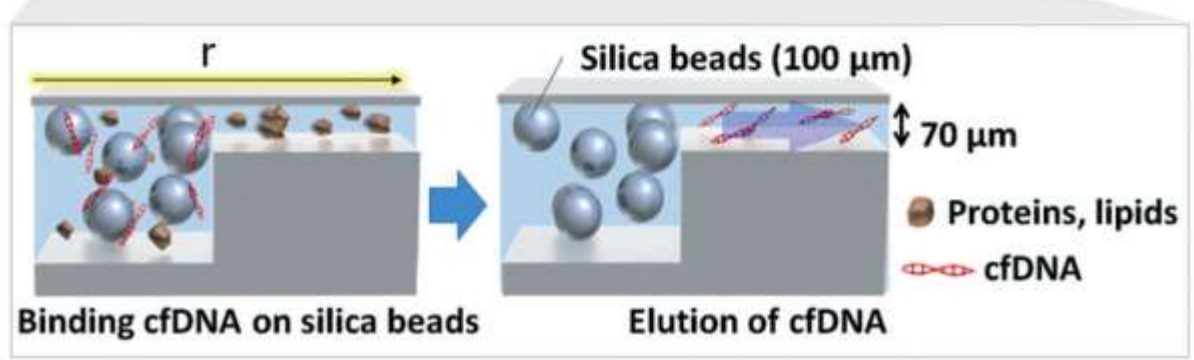


Lab Chip, 2018, 18, 1320–1329

全自動血液游離DNA分離機

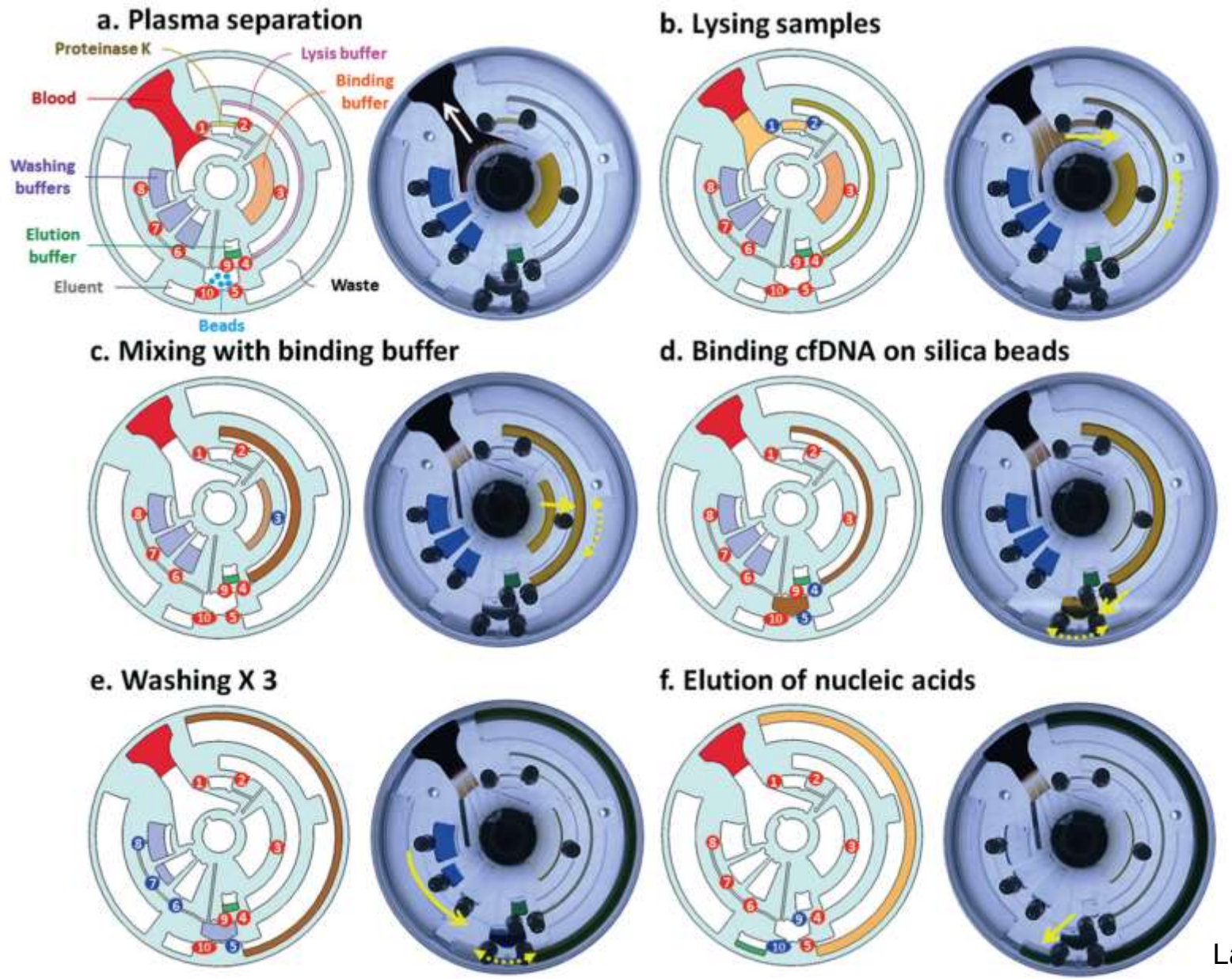






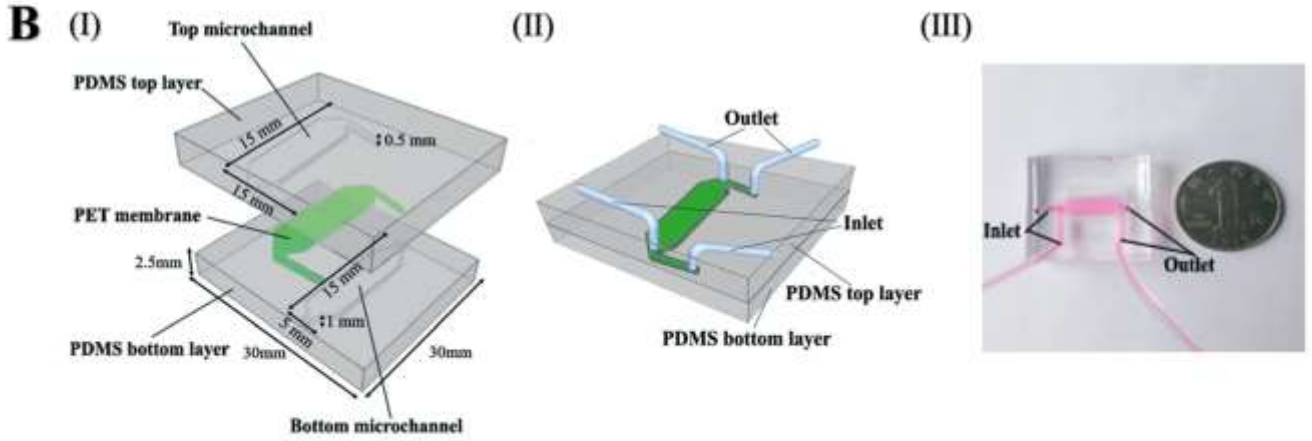
Lab Chip, 2018, 18, 1320–1329

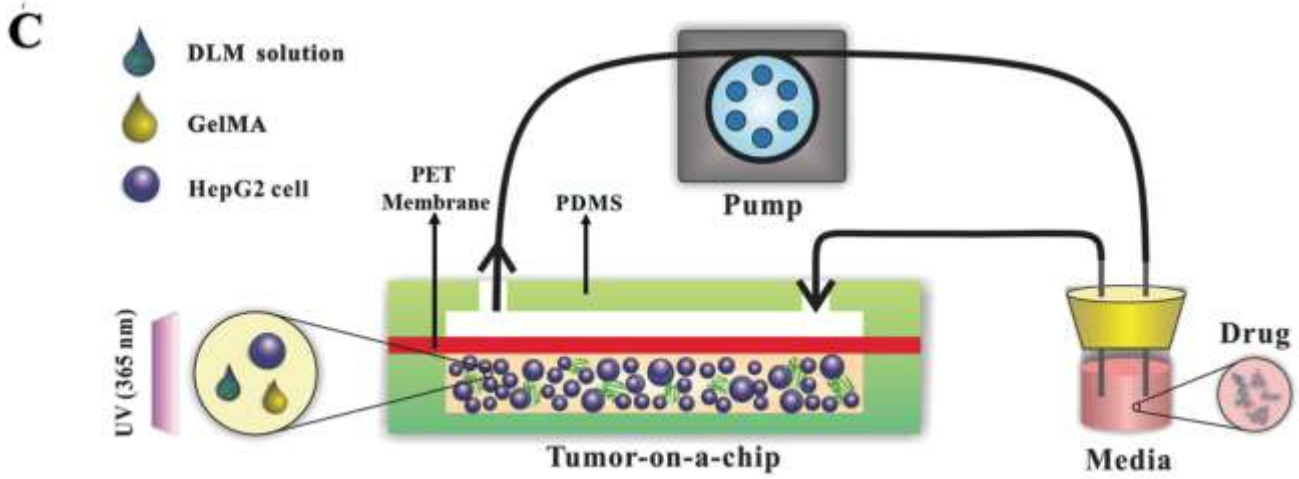
全自動血液游離DNA分離機

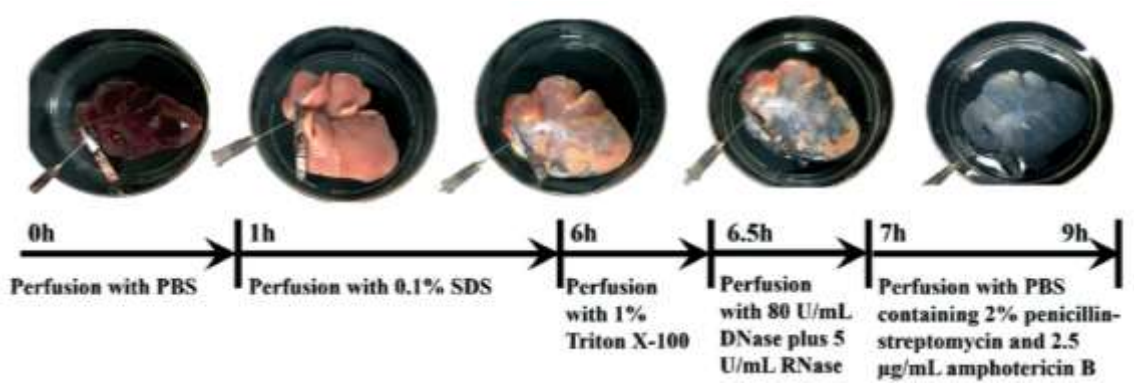


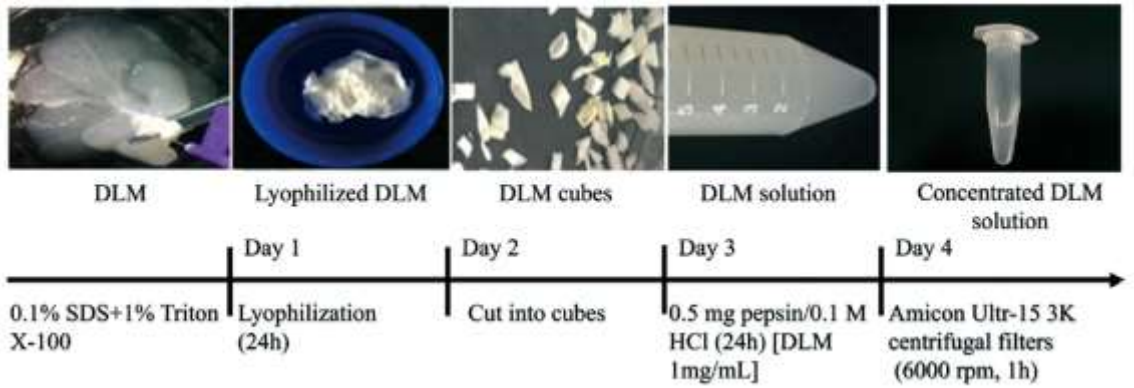
Lab Chip, 2018, 18, 1320–1329

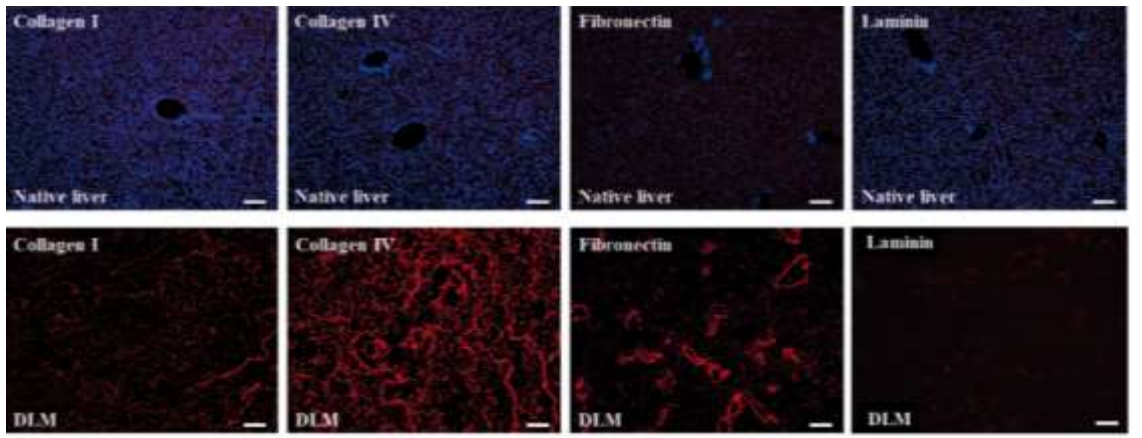
利用晶片建構肝臟環境進行藥物篩選











Lab Chip, 2018, 14, 359–368


Q.
A.