미세유체역학과 진단기술

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Disease Diagnostics

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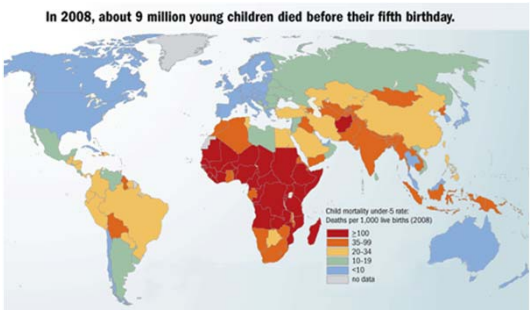
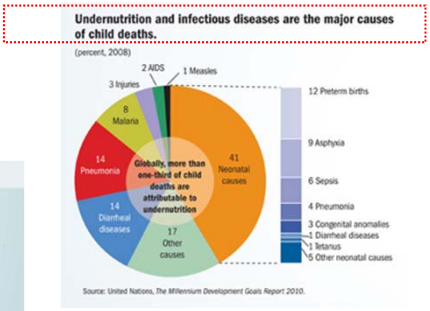
Infectious Disease Diagnostics

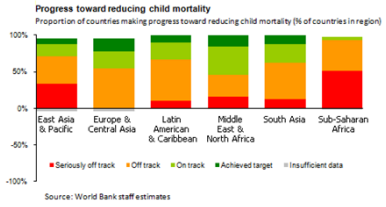
- **#2** cause of death worldwide
  - #1 in developing countries
- Wide number of organ systems affected
- Tremendous health economic burden
  - $1.7 billion in US annually
- Timely recognition is critical
  - Meningitis
  - Sepsis
  - Influenza
  - Sexually transmitted diseases

Disease Diagnostics

Infectious diseases
in developing countries







Disease Diagnostics

Infectious disease diagnostic: Blood culture

- Inadequate Gold Standard
  - Prolonged time to detection (>18 hours)
  - Poor detection sensitivity
    - Prior antibiotic administration
    - Fastidious organisms
  - Increased biohazard risk
    - Propagation of potentially highly contagious pathogens
  - Resource demanding
    - Hospital based laboratory
- Conservative management approach
  - Unnecessary hospitalizations
  - Empiric broad-based IV antibiotics
    - Increase drug resistant organisms

Disease Diagnostics

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Design constraints in developing countries

Figure 1 | Diagnostic testing sites with minimal and no laboratory infrastructure. (a) Diagnostic testing site in Cameroon with no laboratory infrastructure. Reagents, devices and/or equipment must be able to function at ambient temperature, without electricity, running water or a sterile environment. Tests should be completed rapidly so that results can be provided to the patient before leaving the site. Photo provided by J-P. Bonn (BBT Partners, Paris, France). (b) Diagnostic testing site in Uganda with minimal laboratory infrastructure. The site might have running water, has electricity and has limited equipment, but is at ambient temperature. Photo provided by D. C. Hay Burgess courtesy of the Bill & Melinda Gates Foundation, Washington, USA.

Disease Diagnostics

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Design constraints in developing countries

- minimal use of laboratory infrastructure
  (electrical power, clean water, and cold storage)
- battery- or solar-powered
- easy-to-interpret results
- Self-calibration with controls
- single-use, disposable, inexpensive

Table. Characteristics of the ideal diagnostic test – ASSURED

Affordable by those at risk of infection
Sensitive (few false-negatives)
Specific (few false-positives)
User-friendly (simple to perform and requiring minimal training)
Rapid (to enable treatment at first visit) and Robust (does not require refrigerated strorage)
Equipment-free
Delivered to those who need it

Appropriate Technologies

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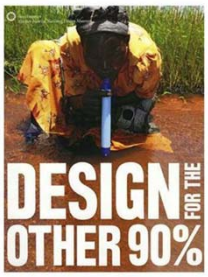
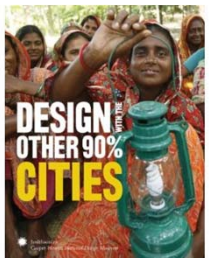
소외된 90%를 위한 기술
(technology for the other 90%)

intermediate technology
Dr. Ernst Friedrich Schumacher, 1966

•적은 자원을 사용하며 (small scale, energy efficient)
• 유지하기 더 쉽고 (sustainable, locally controlled)
• 환경에 적은 영향 (environmentally sound)

사회 기술, 대안기술, 중간기술, etc.
→ people centered technologies





Appropriate Technologies

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PRACTICAL ACTION

Practical Action
http://practicalaction.org

"빈곤에 도전하는 기술"
미개발국의 빈곤을 개선하기 위해 지속 가능한 기술을 개발하고 적용하는 기관. 1966년 슈마허에 의해 ITDG로 창립.
에너지, 주택, 물, 교통, 재난방재, 음식과농업 문제들을 중심으로 방대한 자료와 경험을 축적하고 있음

Transport expertise
Cycle trailers
Animal-drawn carts
Road building
Gravity ropeways
Tuin river crossings

People stories
Road building
Aerial ropeway
Animal-drawn carts
Bicycle ambulances
Gravity ropeways

Water and sanitation
Farming
Rainwater harvesting
Irrigation
Access to sanitation

People stories

Strategy and research findings

Water and sanitation projects
Darfur rural livelihoods
Eastern Sudan
Disaster mitigation
Nyamarimbira
Community energy
Vilcanota valley
Animal health
Maasai housing
Arsenic mitigation

Shelter expertise
Earthquake resistant houses
Maasai houses
Stabilised soil blocks
Brickmaking cooperatives
Enabling housing standards
Women in construction

People stories

Strategy

Research
Knowledge and information systems
Regulatory guidelines for urban upgrading (RGUU)
RGUU workshop
RGUU discussion
Integrated urban housing development
World Urban Forum

Shelter projects

Energy expertise
Improved stoves
Indoor air pollution
Micro-hydro
Solar power
Biogas
Small-scale wind power

People stories
Biogas
Smoke hoods
Microhydro
Improved fuel efficiency
Wind power

Research and strategy
Energy publications
Small-scale hydro power
Smoke, health and household energy

Energy projects
Smoke and health
Street foods
Urban waste management
Sparknet

Appropriate Technologies

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적정기술과 해외사회적기업 사례

KickStart

아프리카의 소농들을 위한 값싼 족동식 펌프

고지대 주민의 농업생산량을 10배 높이는 효과

사회적기업화 및 펌프판매를 통해 85,600개의 일자리를 창출

가난한 이들을 위한 혁신적 사회적 기업사례가 국제적으로 증가되고 있음.

Q DRUM

평균 8km를 걸어가 물을 길러야 하는 아프리카주민들과 아이들

78L의 물을 편리하게 길을수 있는 값싸고 간단한 기술
가난한 사람들의 삶에 적정하게 개발된 사람의 얼굴을 한 기술

LifeStraw

흙탕물을 먹어야 하는 아프리카의 아이들 매일 6,000명이 먹는 물로 인해 사망

이동하면서 물을 찾았을 때 마실 수 있는 발대형 정수기
골인 물과 같은 수준의 정수력
1년 이상 사용가능하고 값싼 정수빨대
가난한 사람들을 위한 기술력

Good Neighbors

Point of Care Diagnostics

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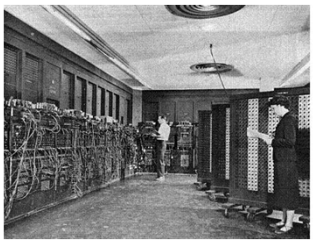
Medical need: Rapid point-of-care diagnostics

- Ideal diagnostic test for infectious diseases
  - Rapid turn-around time
  - Broad-based & accurate
  - Automated
  - Growth independent
    - reduced biohazard risk
    - Sensitive despite prior antibiotic use
  - Portable
  - Low cost
  - User Friendly
    - “Sample-in, Answer-out”
  - Answer these questions
    - “Does the patient have a bacterial infection?”
    - “If so, what is the organism and is it highly contagious?”
    - “What should be the initial antibiotic of choice and infection control measures?”

Lab on a Chip

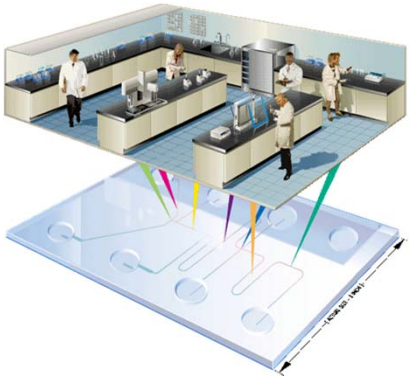
Lab-on-a-Chip (LOC)

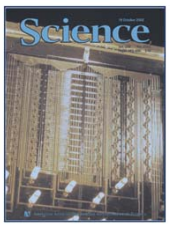


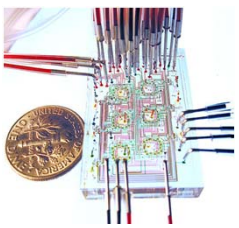
LOC

Lab on a Chip

- A device that performs laboratory functions on a microchip platform for generation, manipulation, or analysis of (bio)chemical information







Key enabling technology

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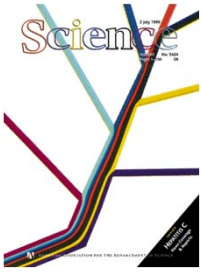
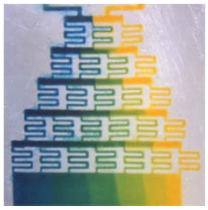
Microfluidics

Emerging technology that allows development of new approaches to synthesize, purify, and rapidly screen chemicals, biologicals, and materials using integrated, massively parallel miniaturized platforms.





http://www.youtube.com/watch?v=p08_KlTKP50

Target Species and Samples

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- Target species – DNA, Virus, Bacteria, Cell and etc.
- Samples are typically in the form of colloidal suspension
  – dispersed bioparticles in liquid media (water, food matrices, physiological liquids, and etc.)

	10^{-3} m (1 mm)	Microfluidic Device Scale
Human hair	10^{-4} m (100 μm)	
Cell	10^{-5} m (10 μm)	
	10^{-6} m (1 μm)	
	10^{-7} m (100 nm)	
Virus	10^{-8} m (10 nm)	
DNA	10^{-9} m (1 nm)	
Atom	10^{-10} m (1 A)	