Microfluidics

Jens Ducrée

School of Physical Sciences
Dublin City University
Ireland

Email: jens.ducree@dcu.ie

Overview

1. Introduction

2. Fluids

1. General Characteristics
2. Dispersions
3. Thermodynamics
4. Transport Phenomena
5. Solutions
6. Surface Tension
7. Electrical Properties
8. Optical Properties
9. Biological Fluids

3. Physics of Microfluidic Systems

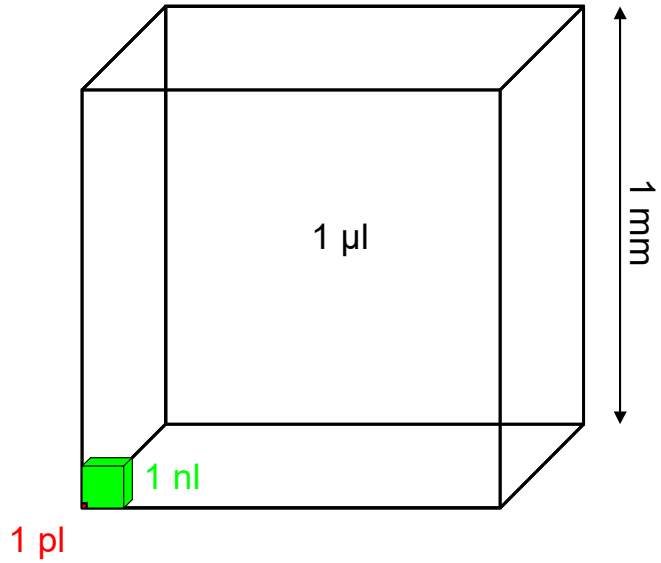
1. Navier-Stokes Equation
2. Laminar and Turbulent Flow
3. Fluid Dynamics
4. Fluid Networks
5. Energy Transport
6. Interfacial Surface Tension
7. Electrokinetics

Content

What is microfluidics?

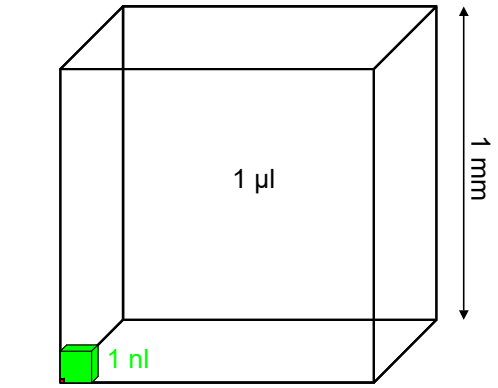
- „Fluidics“ means handling of liquids and / or gases

- „Micro“ means at least one of the following features
  - **small volumes (µl; nl; pl)**
  - small size
  - low energy consumption
  - use of special “micro” effects ...

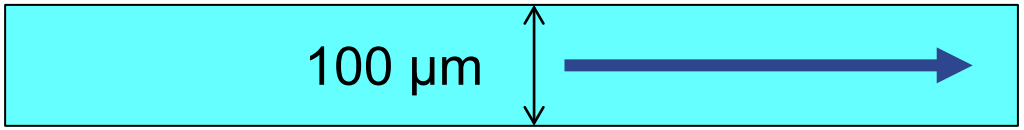


Volumes and Flow Rates

- Typical volumes on µl-scale, i.e., mm^3, can be stored on common microfluidic chip formats
  - Cube with 100 µm edge length ↦ 1 nl, only!
  - Large volumes by numbering up



- Volume flow rates: ~µl per min
  - Cross section: $A = 100\ \mu m \times 100\ \mu m = \frac{1}{100}\ mm^2$
  - Flow velocity: $v = 1\frac{cm}{min} = 10\frac{mm}{min}$
  - Throughput per channel: $Q = A \times v \approx 0.1\ \frac{\mu l}{min}$



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electronic fountain pen

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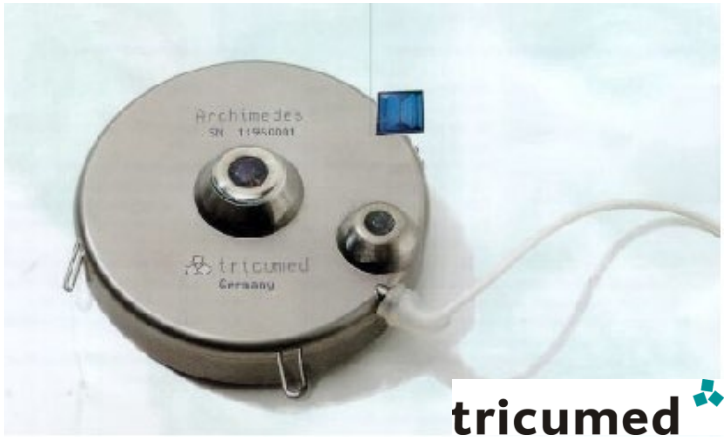
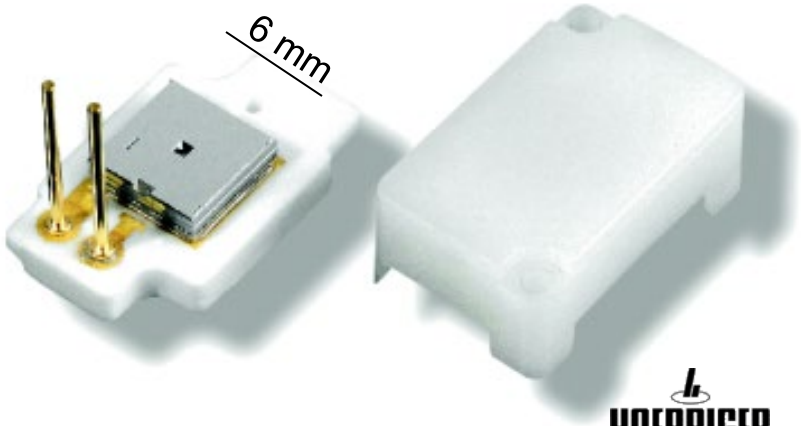


Implantable Drug Delivery System



MegaMic microvalve for gases

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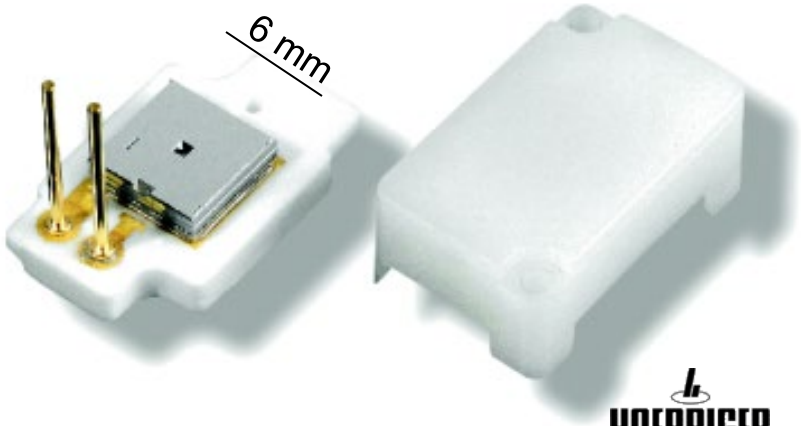

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    → surface tension

From the movie „ANTZ“ (Universal Pictures)

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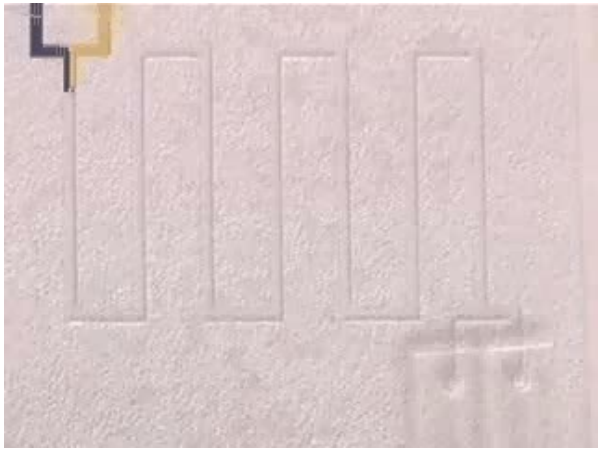
    - → surface tension
    - → laminar flow



demonstration of laminar flow (Nanostream; USA)

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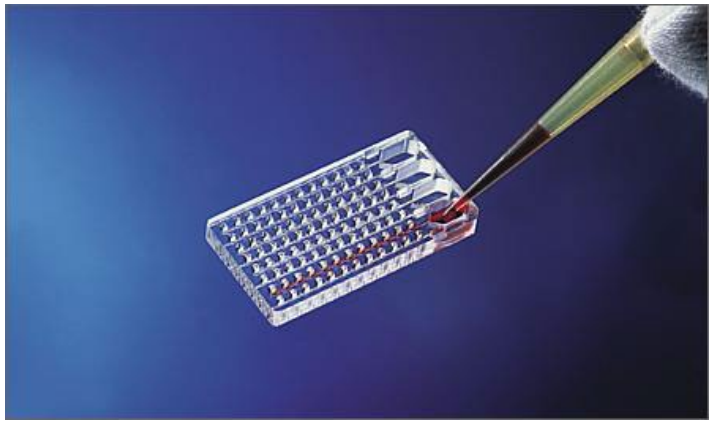
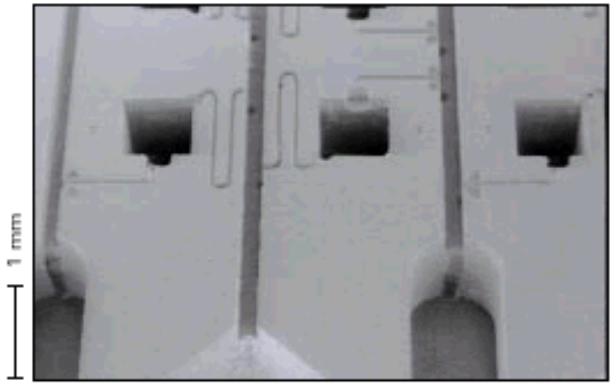
    - → surface tension
    - → laminar flow
    - → capillary forces
    - → ...



usage of capillar flow
(STEAG Microparts & Merlin; Germany)



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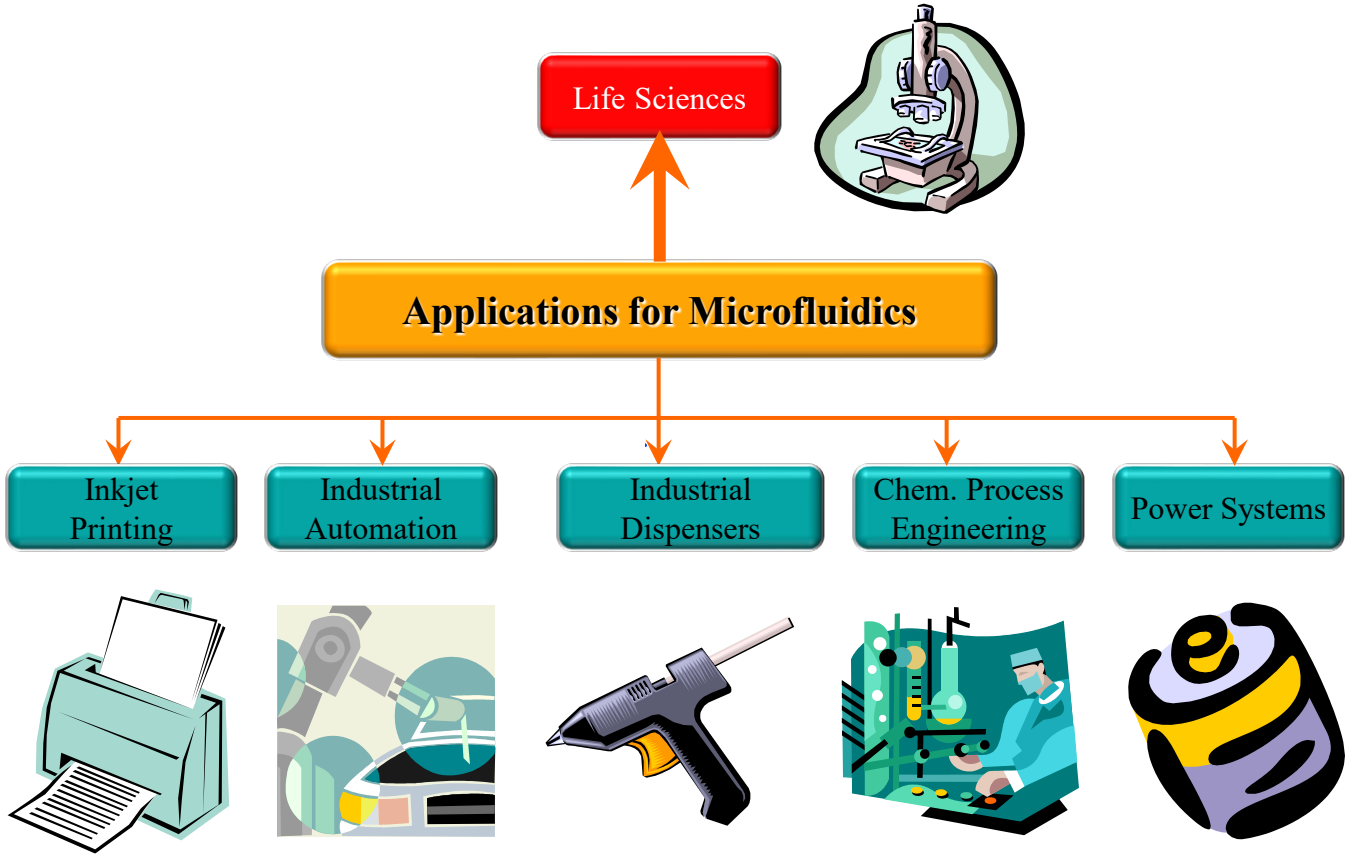
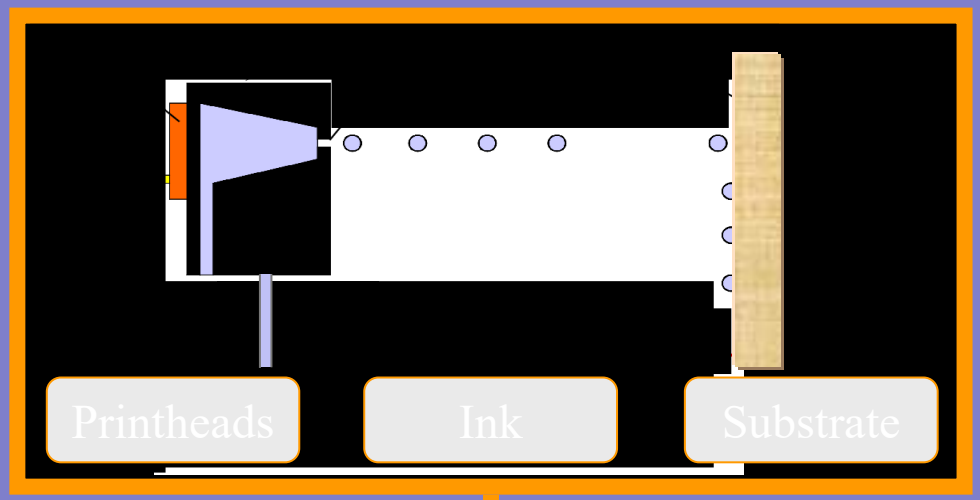

Life Sciences
Applications for Microfluidics
Inkjet Printing
Industrial Automation
Industrial Dispensers
Chem. Process Engineering
Power Systems

Markets for Microfluidics



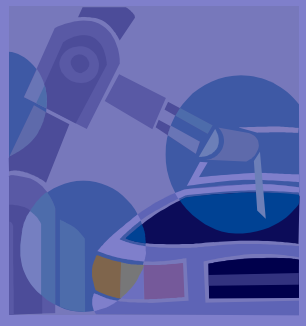
Printing

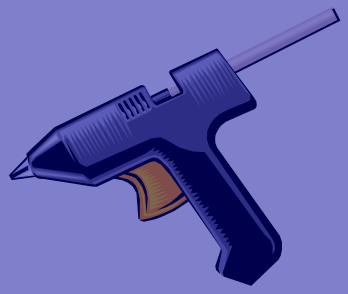
Industrial Automation

Industrial Dispensers

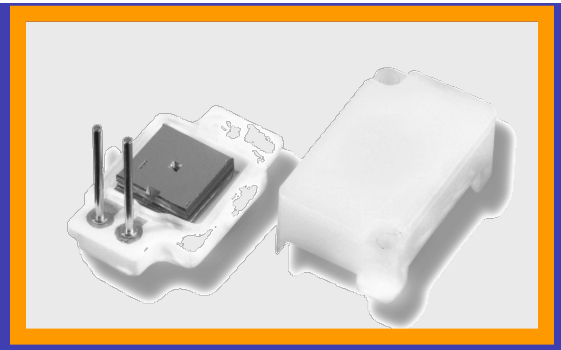
Chem .Process Engineering

Power Systems





Markets for Microfluidics



Pneumatics

Flow Control

Sensors

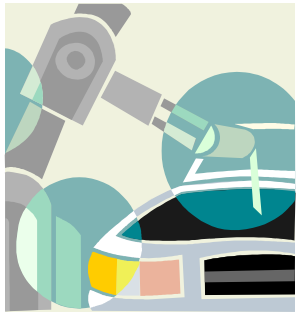
Printing

Industrial Automation

Industrial Dispensers

Chem .Process Engineering

Power Systems



Markets for Microfluidics

Technical

Agro- Food

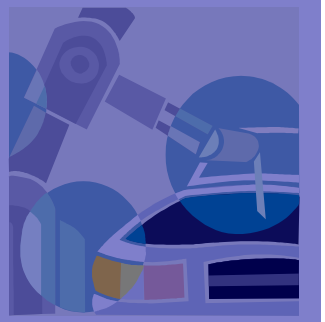
Printing

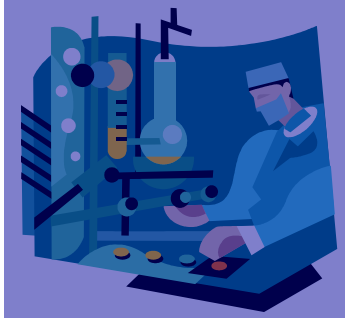
Industrial Automation

Industrial Dispensers

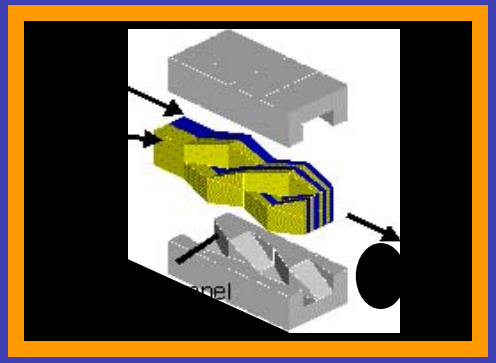
Chem .Process Engineering

Power Systems

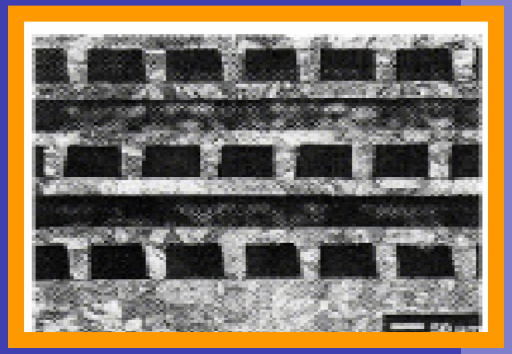




Markets for Microfluidics



Micromixers

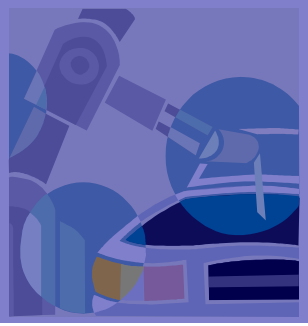


Heat Exchangers

Microreactors

Printing

Industrial Automation

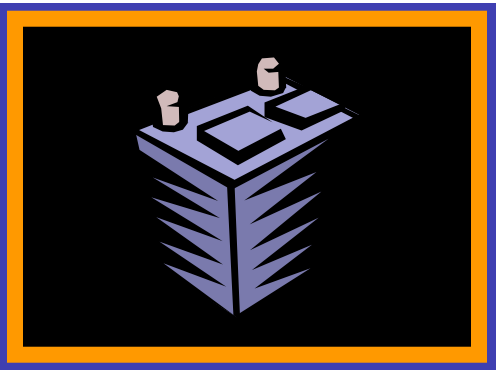


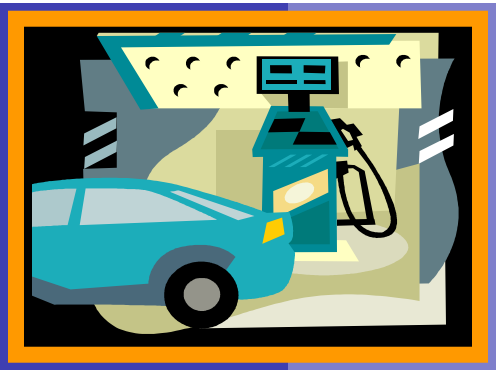
Industrial Dispensers

Chem. Process Engineering

Power Systems

Markets for Microfluidics





Fuel Cells

Micro-combustors

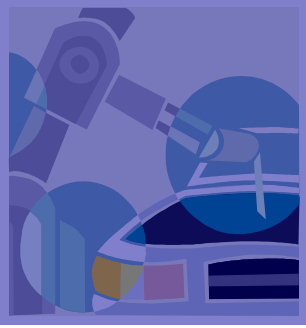
Printing

Industrial Automation

Industrial Dispensers

Chem .Process Engineering

Power Systems



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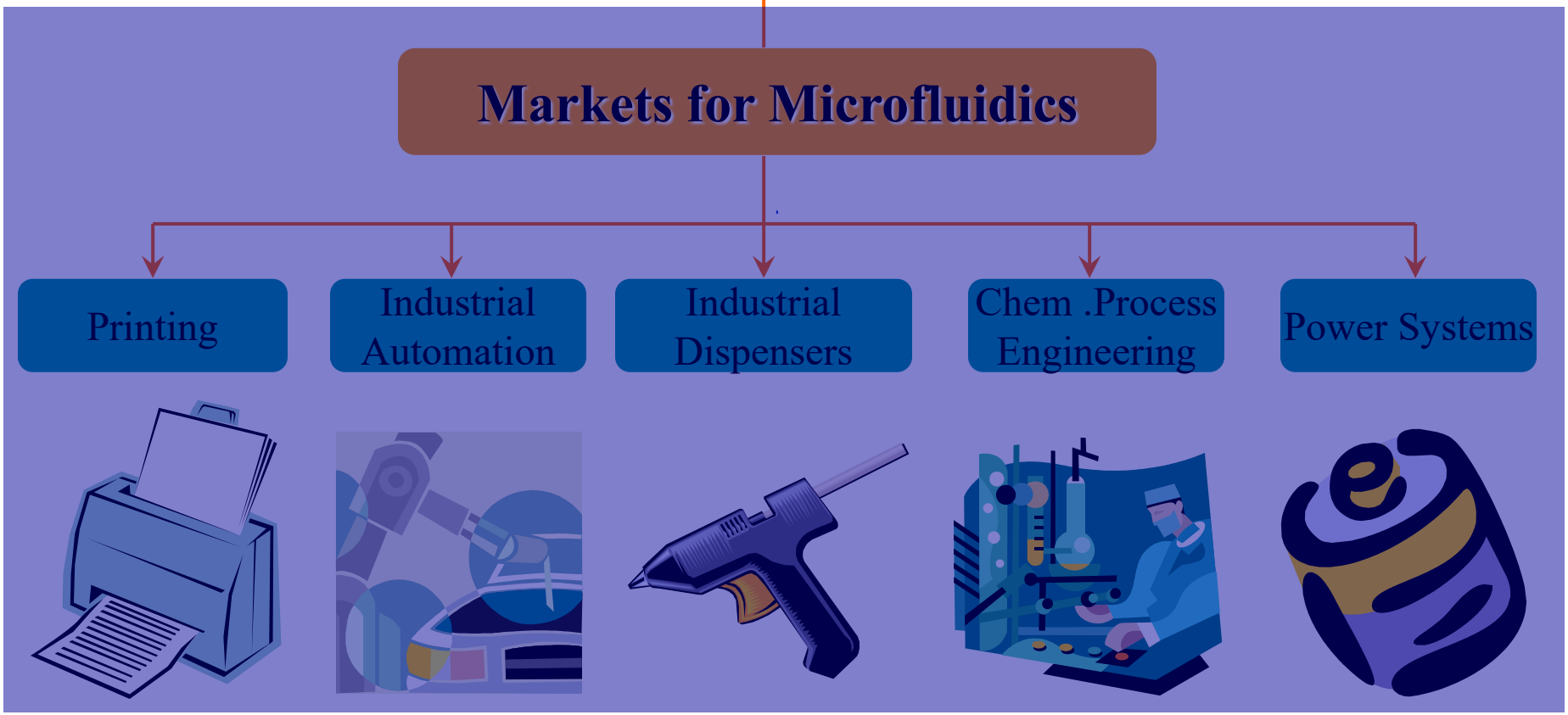
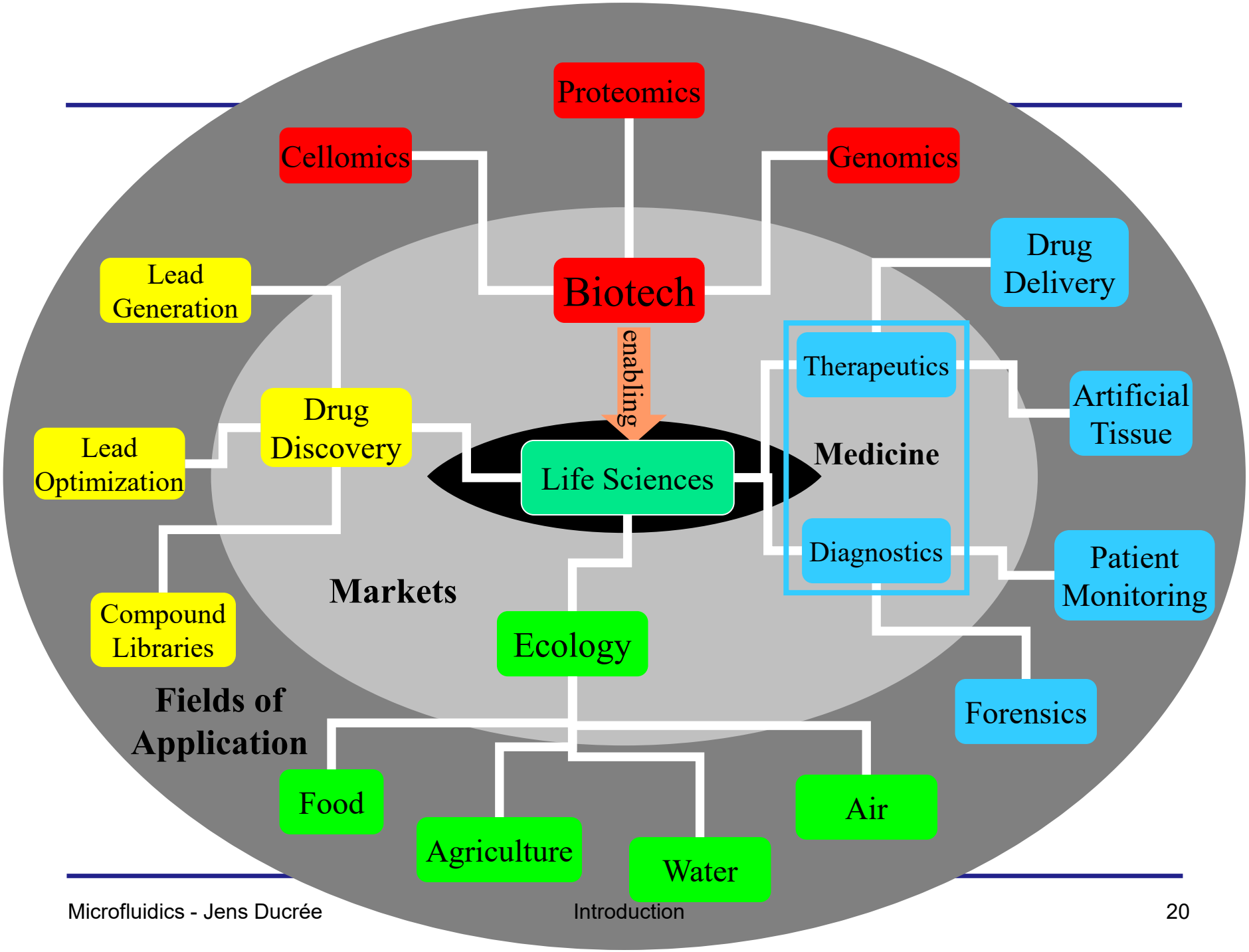
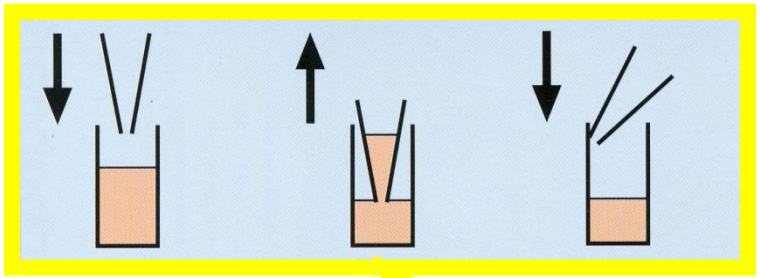


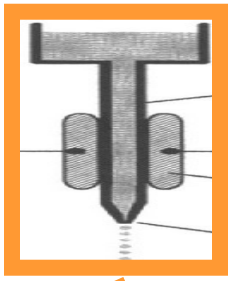

Proteomics
Cellomics
Genomics
Lead Generation
Biotech
Drug Delivery
enabling
Therapeutics
Artificial Tissue
Drug Discovery
Lead Optimization
Life Sciences
Medicine
Diagnostics
Patient Monitoring
Markets
Compound Libraries
Ecology
Fields of Application
Forensics
Food
Agriculture
Air
Water

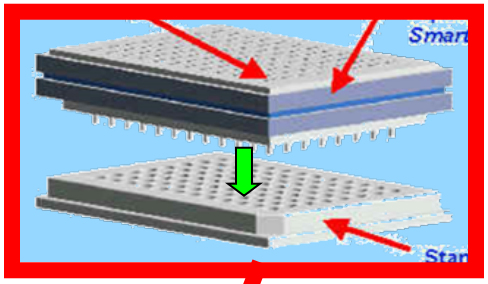
Product Groups and µFluidic Technologies

Product Groups	µFluidic Technologies		
Liquid Handling	Pipetting	Dispensing	Well Plate Technology
Particle Laden Fluids	Particle Counting	Particle Manipulation	Particle Separation
Flow Control	Valving	Pumping	
Sensing	Flow Sensing	Biosensitive Transduction	On Chip Detecion
Lab on a chip	On Chip Separation	On Chip Mixing	On Chip Reacting
Microarrays	Arraying	Microarray Substrates	

Product Groups and µFluidic Technologies







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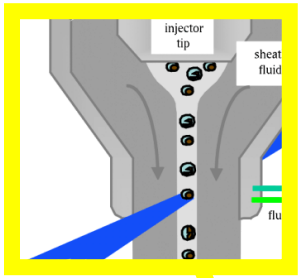

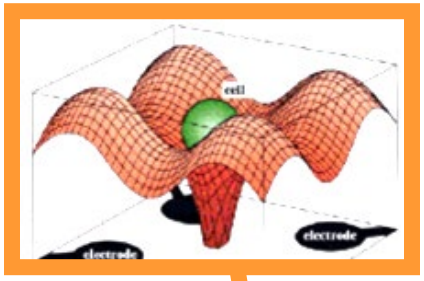

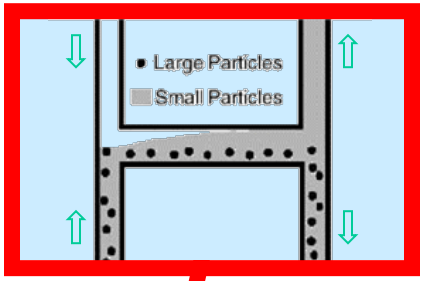

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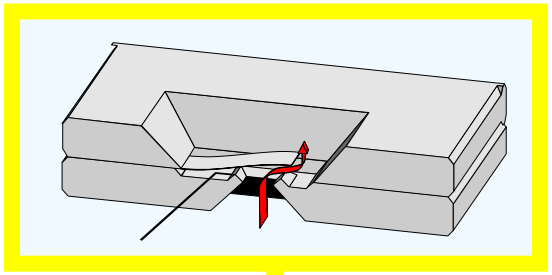

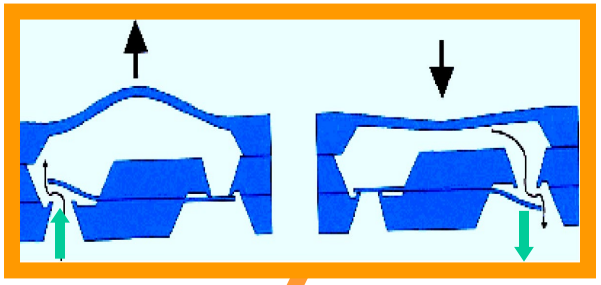

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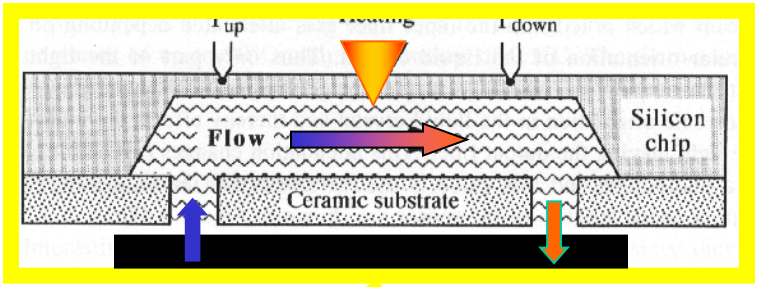

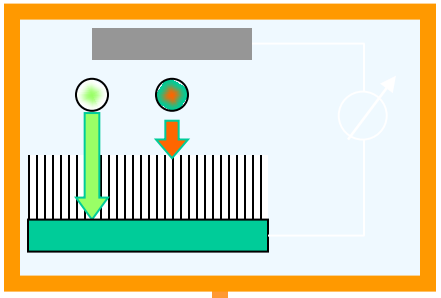

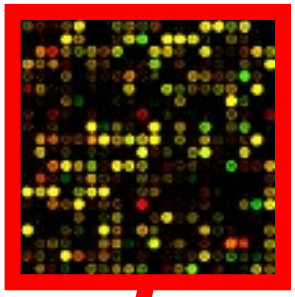

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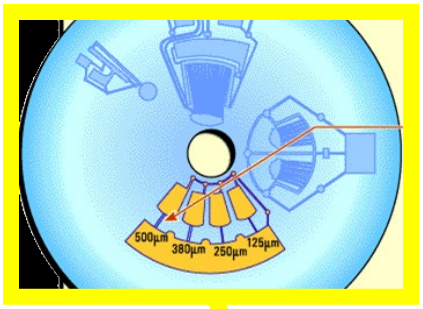

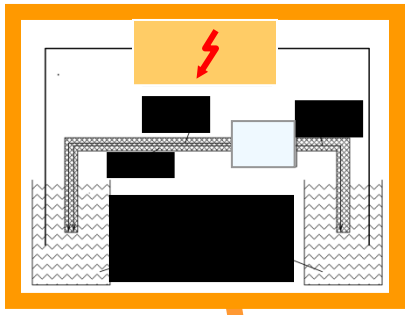

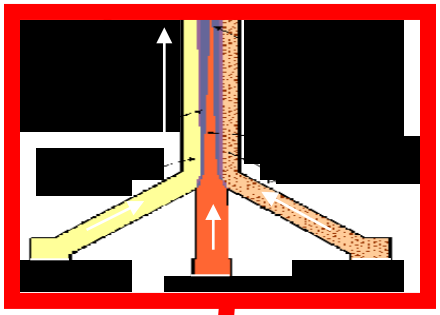

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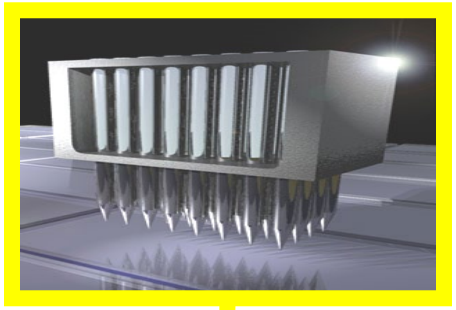

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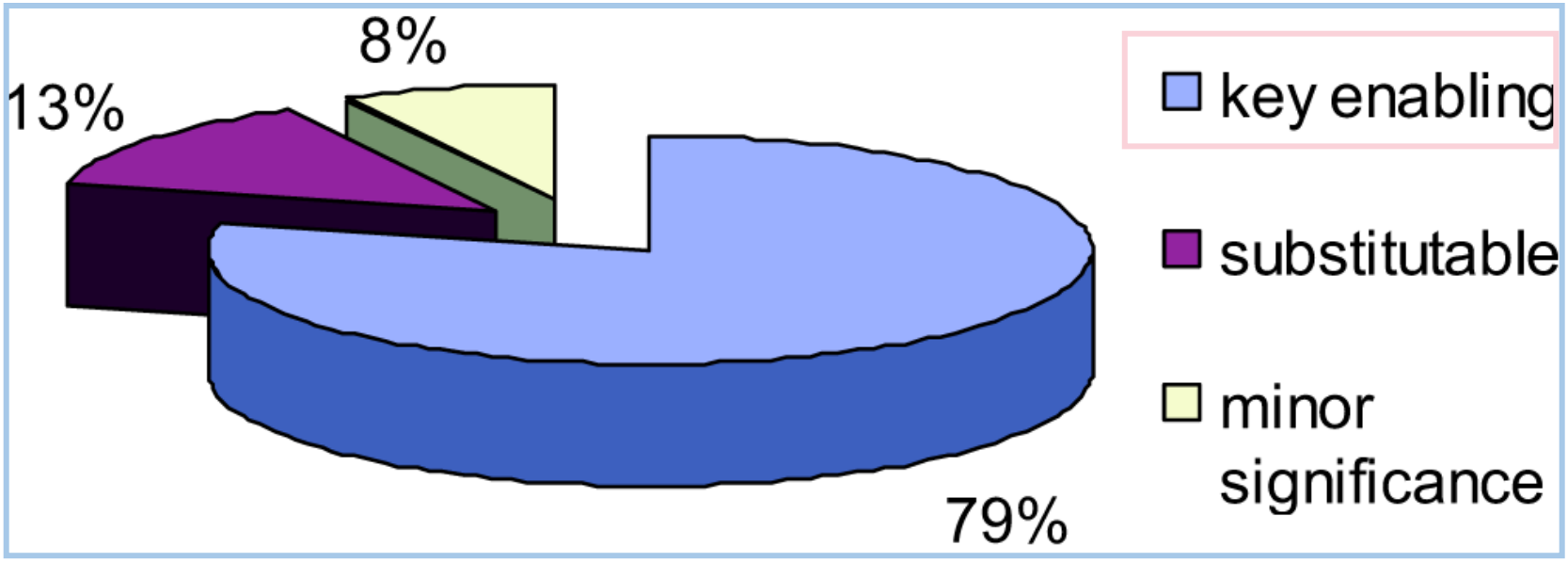
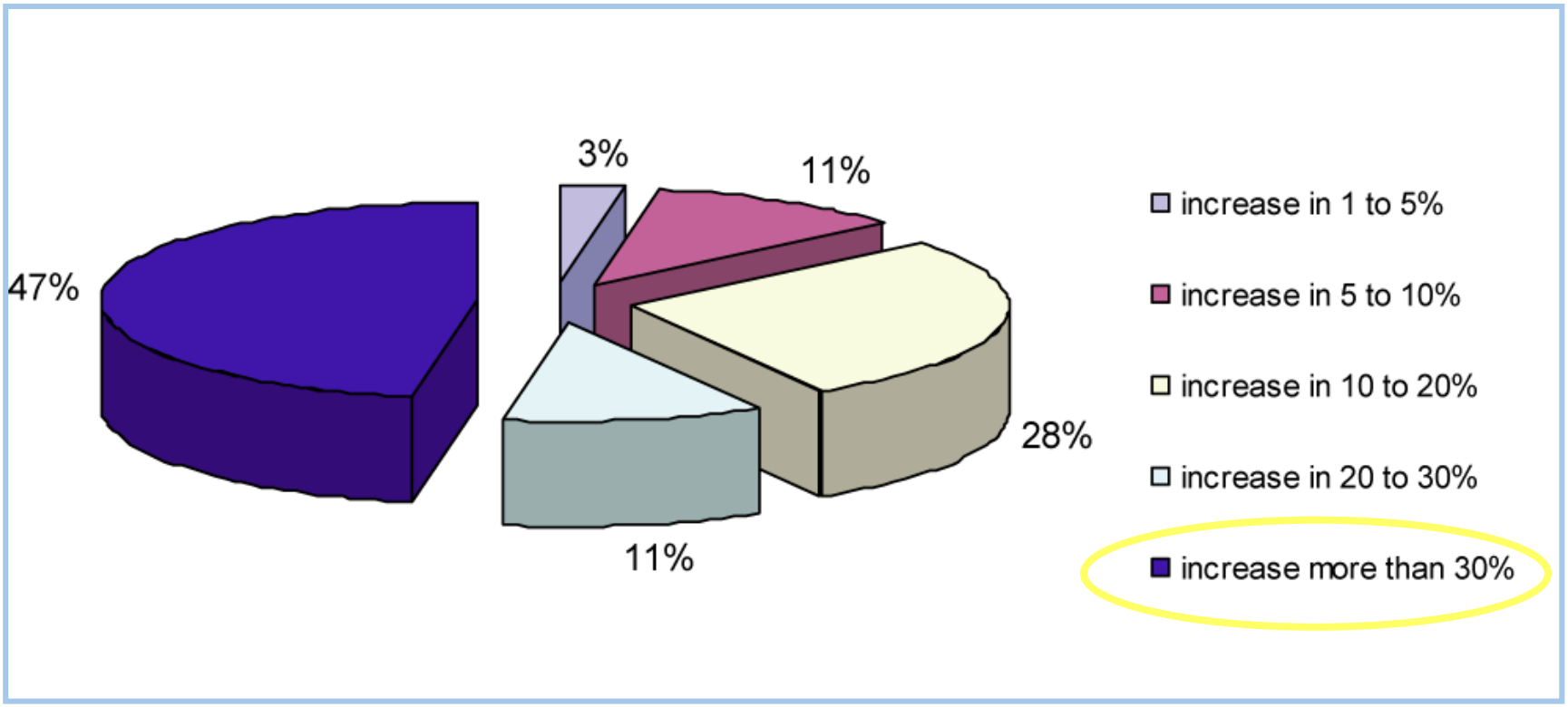
Technical Significance of µFluidics



Expected Market Growth in 5 Years



Companies in Ireland (Selection) → Jobs

Gen Cell biosystems

ANALOG DEVICES

BD

biosensia

Trinity Biotech

Radisens DIAGNOSTICS

Alere™

MERCK MILLIPORE