

# EVS 3120

## Part 2: Biotechnologies

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### Course outline

- Introduction
- Applications in Agriculture and Food microbiology
- Applications in metal recovery
- Applications in waste treatment:  
Bioremediation of contaminated sites

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### Introduction

Industrial microbiology: discipline that uses microorganisms to produce

- ◆ valuable commercial products: wine, beer, etc.
- ◆ pharmaceutical agents (antibiotics)
- ◆ food additives, enzymes
- ◆ Chemical products (acetic acid, butanol, etc.)

Microbial biotechnologies:

- ◆ Gene manipulation: new microbes

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## Industrial microorganisms

- Selected natural microorganisms that have been modified: metabolic specialists
- Modified by mutation or recombination to enhance the production of specific metabolites and repress minor ones
- Source: natural environment and culture collection (ATCC)

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## Requisites for an industrial microorganism

- Available in pure culture
- Genetically stable
- Must grow in large-scale culture
- Maintain live cultures for long time
- Should form spores to be easily re-inoculated
- Grow rapidly and produce the desired product in short period of time
- Grow in cheap liquid medium: whey, corn-steep liquor
- Not harmful to humans or plants
- Easy to remove the cells from culture medium: large cells
- Amenable to genetic manipulations and recombination

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## Kinds of industrial products

- Cells themselves (yeasts, mushrooms)
- Enzymes
  - Starch-digestive enzymes (amylases)
  - Protein-digestive enzymes (proteases, rennin)
  - Fat-digestive enzymes (lipases)
  - Glucose isomerase (glucose and fructose sweetener)
  - Penicillin acylase
- Pharmaceutical products; antibiotics, steroids, etc.

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## Kinds of industrial products

- Food additives
  - Amino acids
  - Aspartic acid (aspartame)
  - Glutamic acid, lysine, vitamins (C, B<sub>12</sub>, riboflavin)
- Chemicals
  - Ethanol (fermentation by the action of yeast)
  - Acetic acid
  - Lactic acid
  - glycerol

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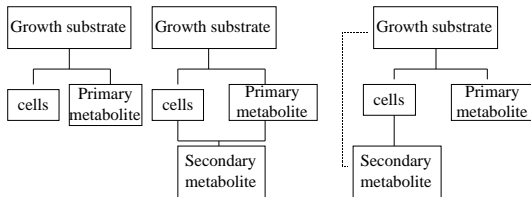
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## Growth and product formation



Primary metabolite: produced during primary growth phase  
Secondary metabolite: produced near the end of growth phase

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## Microbial metabolites

- Primary metabolites
  - Alcohol (ethanol) fermentation: yeasts, bacteria
  - Ethanol formation is parallel to cell growth
- Secondary metabolites
  - Antibiotics
  - Not essential for growth and reproduction of microorganisms
  - Formation is function of growth conditions

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## Secondary metabolites

- complex organic molecules that require a large number of specific enzymatic reactions for synthesis
- Antibiotic tetracycline: 72 steps
- Antibiotic thromycin: 25 steps

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