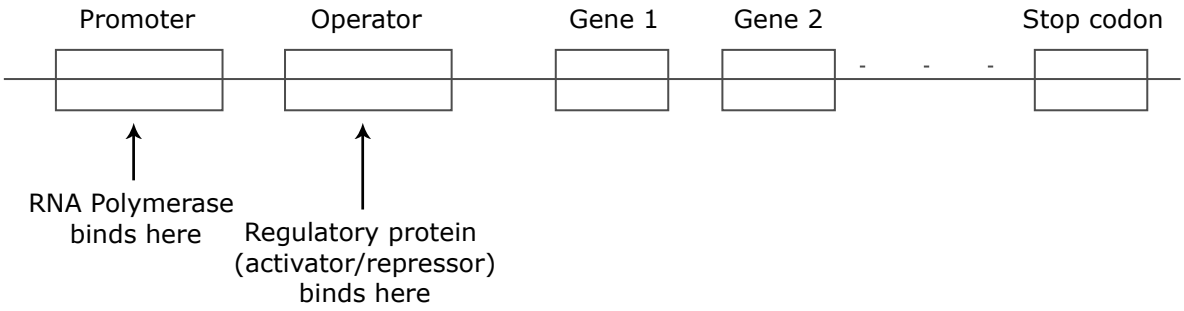
1.89, Environmental Microbiology
Prof. Martin Polz
Lecture 14

Regulation (cont.)

2. Enzyme levels

   Transcription:



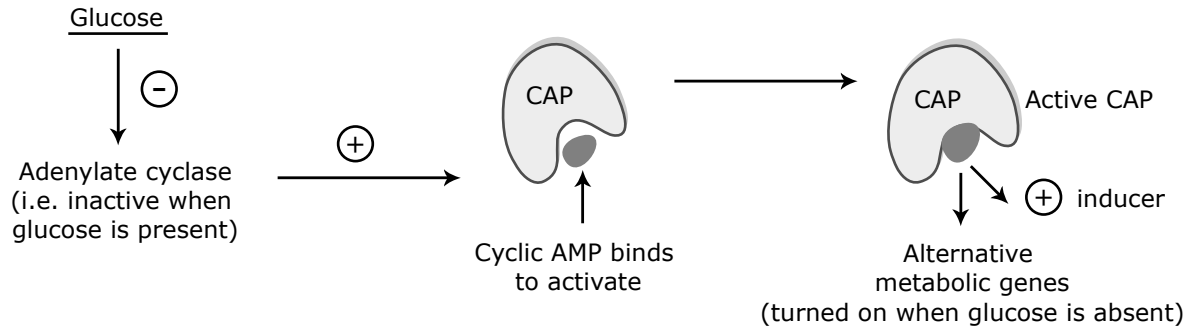
   mechanisms. Example: attenuation, small RNAs

3. Global control networks

   Example:
   - Limitation of C, N, P → can't use carbon if you have no N to grow.
   - Damage:
     - Oxidation
     - Radiation
     - Temperature
     - Osmosmotic
   - Redox reactions: e^- transport chains
   - Catabolite repression: if preferred carbon source is available, other substrates often remain untouched

     Example:

     - Diauxic growth (glucose, lactose used) uses CAP (Catabolite Activator Protein)



- Quorum sensing: signal "density of similar cells".
  Example: uptake of DNA by G^+ cells
  - Modulated by <u>autoinducer</u> molecules=small diffusible molecules produced at low but constant levels by the cell
  - Autoinducer molecules induce their <u>own transcription</u> & <u>other pathways</u>
  - Local concentration of autoinducer can reach a critical level at which point it induces increased production of itself → strong inducer of other pathways
- Signal transduction & 2-component regulatory systems
  - sensory kinases: example: motility

    Motility → <u>chemotaxis</u>: attractants
    repellants

    CCW (Counter Clock Wise) → run, CW → tumble

  - Tranducers (MCP protein) binds signal (attractant)
    - Che A autophosphorylates
    - Che A ~Ⓟ has a high tendency of phosphorylation for Che Y
    - Che Y ~Ⓟ binds to flagella are motor → clockwise rotation
    - Che Z dephosphorylates Che Y ~Ⓟ

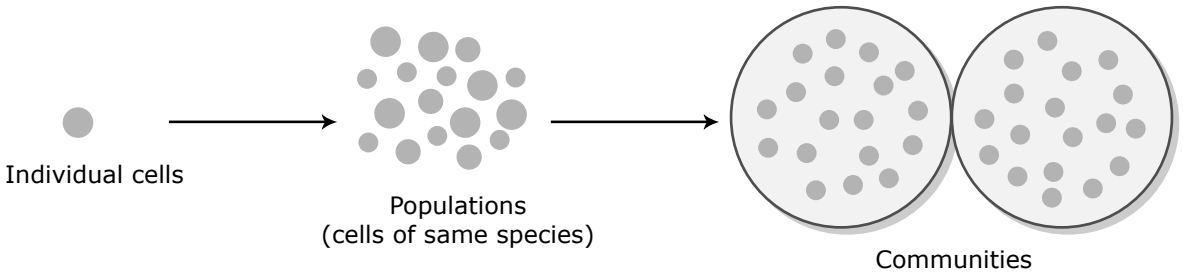
The CW tumble allows the bacterium to explore a small area where it senses as attractant

<u>Adaptation</u> – signal (attractant) does not change, so response goes down.

At this point Che A ~Ⓟ phosphorylates Che B (but at a slower rate). Che B ~Ⓟ demethylates the transducer (MCP) (Che are methylated transducer).

Microbial Ecology

- explore how diverse & abundant bacteria are in the environment & their ecological/biogeochemical function



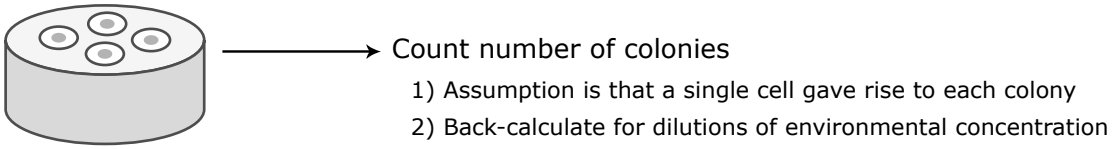
Change in our perception of microbial diversity

1. direct cell counts replaced plate counts

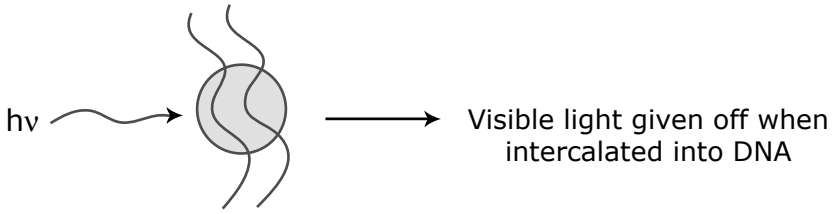
2. molecular approaches for estimating diversity

1970's: "Great plate count anomaly"

- CFU (Colony Forming Units): spread dilution of samples onto culture plates



- Direct Counts: Fluorescent dyes (acridine orange, DAPI)



  - Fix the cells with aldehydes
  - Mix with dyes
  - Observe under fluorescent microscope

Conclusion
Less than 1% of observable cells are easily culturable → direct counts got way higher numbers than CFU method.