Tenets for Successful Integrated Research (sample issues)

- Analyze common/identical samples
- Samples must be reproducible
- Initial samples must be obtained from homogeneous culture
- Chemostat cultures meet operating criteria
Why Use Chemostats

**Batch**

- **Advantages**
  - Easy
  - Inexpensive
  - Traditional

- **Disadvantages**
  - Uncontrolled
  - Growth rate ($\mu_{\text{max}}$)
  - Poor mass transfer
    - $\text{O}_2$, $\text{CO}_2$, $\text{H}_2$, $\text{CH}_4$…
    - Anoxic at low culture densities

**Chemostats**

- **Advantages**
  - Control
    - Growth rate (= dilution rate)
    - pH, $\text{O}_2$, $\text{CO}_2$
    - Culture density

- **Disadvantages**
  - Reproducible
  - Expensive?
    - Capital equipment
    - Labor
  - Non-traditional (learning curve)
### Federation Sample Table

<table>
<thead>
<tr>
<th>Sample</th>
<th>Electron acceptor</th>
<th>DOT (% of air saturation)</th>
<th>Calcium</th>
<th>Flocs</th>
<th>Growth rate (same as dilution rate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR16.1</td>
<td>O₂</td>
<td>20</td>
<td>+</td>
<td>+</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR16.2</td>
<td>fumarate</td>
<td>0</td>
<td>+</td>
<td>-</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR16.3</td>
<td>O₂</td>
<td>20</td>
<td>+</td>
<td>+</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR17.1</td>
<td>O₂</td>
<td>20</td>
<td>+</td>
<td>+</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR17.2</td>
<td>fumarate</td>
<td></td>
<td>+</td>
<td>-</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR17.3</td>
<td>O₂</td>
<td>20</td>
<td>+</td>
<td>+</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR19.1</td>
<td>O₂</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>0.12 h⁻¹</td>
</tr>
<tr>
<td>CR19.2</td>
<td>O₂</td>
<td>Trace</td>
<td>-</td>
<td>-</td>
<td>0.12 h⁻¹</td>
</tr>
<tr>
<td>CR20.1</td>
<td>O₂</td>
<td>20</td>
<td>+</td>
<td>+</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR20.2</td>
<td>O₂</td>
<td>Trace</td>
<td>+</td>
<td>-</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR21.1</td>
<td>O₂</td>
<td>20</td>
<td>+</td>
<td>+</td>
<td>0.225 h⁻¹</td>
</tr>
<tr>
<td>CR21.2</td>
<td>fumarate</td>
<td>0</td>
<td>+</td>
<td>-</td>
<td>0.225 h⁻¹</td>
</tr>
</tbody>
</table>
Overview of Experiment CR19

Sample 19.1

Aerobic conditions

Sample 19.2

Oxygen-limiting conditions

DO₂, %

Time, hr

O₂↓ (50 to 0%)