

# Anaerobic Digestion- Respiration and Fermentation

## INTRODUCTION

Respiration is most commonly thought of in terms of aerobic breathing, like that in seen in most animals. However, for the purpose of discussing anaerobic digestion, respiration will be defined as the degradation of a molecule in order to nourish the cell. The outputs of respiration are largely carbon, for use in synthesizing cell structures, and energy, In general, bacteria use organic compounds as substrates for respiration.

As you know, respiration ends in the electron transfer chain which requires a final electron acceptor. The acceptor you are most familiar with is oxygen. However, bacteria utilize other acceptors in addition or instead of oxygen. Other electron carriers include nitrate, sulfate, formaldehyde, and carbon dioxide (listed in descending order of energy capacity). If able, bacteria will utilize the most energy efficient carrier. In the case of anaerobic digestion, oxygen is unavailable, respiration is incomplete and collectively termed anaerobic fermentation.

During fermentation, sugars are degraded into molecules such as lactate, alcohol, butyrate, or propionate. Subsequently, butyrate and propionate can be used as substrate by methane-producers.

Note: This lesson plan is designed with a pre or co-requisite lesson in aerobic respiration in mind.

## TASK(S)

### Activity 1 (45 minutes)

Create a Flow Chart

### Activity 2 (50 minutes)

Written discussion

# Anaerobic Digestion- Respiration and Fermentation

## ACTIVITY/PROCESS

Create a Flow Chart

- To depict the stages of anaerobic digestion, based upon the fermentation and methanogen processes.
- Showing which molecules could be used as substrates or produced in each stage.

Discuss, in 1000 words or less, the implication of these processes if oxygen were to enter the system.

## RESOURCES

Excerpt from The Microbiology of Anaerobic Digesters. Gerardi, M. John Wiley & Sons, Inc. Canada (2003). Chapter 4: Respiration pp 31-38.

Excerpt from The Microbiology of Anaerobic Digesters. Gerardi, M. John Wiley & Sons, Inc. Canada (2003). Chapter 6: Fermentation pp 43-50.

## ASSESSMENT

- Identify strengths and weaknesses in data collection, graphing, and statistical analyses
- Discuss relationship among the anaerobic processes, and how that can be connected to conservation of mass
- Using data collected, write brief summary of the relationship among pH and biogas production
- Relate the effect that pH changes may have on viability of digestion and the processes that may contribute to those changes.